Mission Operations Support Plan (MOSP) for the Hubble Space Telescope (HST)

Revision 2

September 1996

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

Mission Operations Support Plan (MOSP)
for the
HST

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Preface

The purpose of the Goddard Space Flight Center (GSFC) Mission Operations and Data Systems Directorate (MO&DSD), Code 500, Mission Operations Support Plan (MOSP) for the Hubble Space Telescope (HST) is to provide mission-unique operational procedures and configuration information required by the MO&DSD elements, Jet Propulsion Laboratory (JPL) Deep Space Network (DSN), and Hubble Space Telescope Operations Control Center (STOCC) during MO&DSD and JPL DSN support of the HST Project. Standard procedures for intra- and inter-element operations and for STOCC interface activities are defined in reference documents contained in the appendix of this MOSP. Where referenced conflicts exist with other documents, the provisions of this document take precedence.

The configuration information contained in this document includes both automated data base contents and manual configuration instructions as appropriate to the element. In providing this mission-unique information, this document forms the point of control for automated data bases in use in the MO&DSD and for the manual configurations required.

This issue of the document has been developed to accommodate the needs of normal MO&DSD and JPL DSN operations supporting HST. When appropriate, this document will be upgraded by revision or Documentation Change Notice (DCN) phase information.

Between revision or reissue cycles, all changes to this document, and thus to data bases, manual configurations, and mission-unique procedures contained herein, will be made by DCN. At present, the procedures defined within the Network Control Center (NCC) and Station Interface Procedures, STDN No. 502.16, with the exception of the DCN approval cycle, will be used for DCN implementation. DCNs to this issue will be coordinated with the appropriate MO&DSD line organizations and approved by Codes 501/510.1.

Questions from MO&DSD elements, the JPL DSN, or project organizations concerning the information contained in this document should be transmitted to the Network Control Center (NCC) using Request for Information or Clarification (RIC) procedures as defined in STDN No. 502.16. RICs or DCN/Interim Support Instructions (ISI) responses will be coordinated through Codes 501/510.1, as appropriate. Teletype headers for these messages are contained in Section 16.

All other questions or comments regarding this document may be addressed to:

> NASA/Goddard Space Flight Center
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Section 1. Mission Operations Overview

1.1 Mission Description

1.1.1 General

The Edwin P. Hubble Space Telescope (HST) illustrated in Figure 1-1 is an observatory that on April 24, 1990 was placed in a circular orbit approximately 330 nmi (611 km) in altitude, with an orbit inclination of 28.5 degrees and orbital period of approximately 95 minutes. This position lies well above the obscuring layers of the atmosphere. The HST is expected to observe out to the edge of the observable universe, estimated to be about 14 billion light-years distant. Looking so far in distance will be equivalent to looking back in time at the possible birth of galaxies and quasars billions of years ago. Table 1-1 shows the mission characteristics of HST. Table 1-2 and Figure 1-2 provide the Frequency Utilization Summary for the mission.

1.1.2 Mission Objectives

1.1.2.1

The primary objective of the HST is to provide a high resolution, optical telescope system that will see planets, asteroids, and comets so clearly that the scientific data recorded will significantly extend our knowledge of the universe. In addition, it is to provide an astronomical capability beyond the state-of-the-art ground-based telescopes and to fulfill as many of the scientific and technological requirements as possible within the anticipated mission lifetime of 15 years with in-orbit servicing.

1.1.2.2

The HST seeks to advance the frontiers of knowledge in the following areas:

    a.   The constitution, physical characteristics, and dynamics of celestial entities.

    b.   The nature of processes that occur in the extreme physical conditions in and between astronomical objects.

    c.   The history and evolution of the universe.

    d.   The inquiry into the universality of the laws of nature in the space-time continuum.

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Figure 1-1. HST Payload Description

Table 1-1. HST Frequency Utilization Summary (1 of 2)

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Table 1-1. HST Frequency Utilization Summary (2 of 2)

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Figure 1-2. HST Frequency Utilization

1.2 HST Mission Management Responsibility and Structure

1.2.1 General

NASA's Office of Space Science (OSS), Headquarters, Washington, D.C., is responsible for the overall direction of the HST program.

1.2.2 GSFC Responsibilities

GSFC is responsible for project management and HST mission and flight operations, directing the development and manufacture of the spacecraft ORI/ORU's, and support equipment and the proper integration of all its system elements to ensure efficient operation in space. GSFC has designated management responsibility for the following:

    a.   Overall science instrument acquisition (U.S. instruments).

    b.   HST flight systems and servicing.

    c.   Ground system development and operations.

    d.   Overall management of the HST Science Institute (STScI).

    e.   Follow-on instrument acquisition.

    f.   Follow-on upgrades and Extra-Vehicular Activity (EVA) development for servicing missions.

1.2.3 Flight Projects Associate Director

The Associate Director of Flight Projects for HST has the overall GSFC Project management responsibility for the implementation of Mission Operations and Servicing Missions. The Associate Director's Office is composed of two project elements, the HST Flight Systems and Servicing (FS&S) Project and the Operations and Ground System (O&GS) Project.

1.3 Mission Operations Ground Support

1.3.1 General

The overall mission operations support configuration is shown in Figures 1-3 and 1-4.

1.3.2 Flight Operations

Primary flight operations are performed by the HST project Flight Operations Team (FOT) using HST Payload Operations Control Center (HST POCC) ground system capabilities. Additional flight operations support teams for servicing missions activities will consist of the Johnson Space Center (JSC) Mission Control Center (MCC) and the GSFC Shuttle/POCC Interface Facility (SPIF), which will monitor and analyze mission data to support a variety of planning, scheduling, and operations activities.

1.3.3 Ground System Facilities

1.3.3.1

The HST project FOT operates the HST Observatory from the Space Telescope Operations Control Center (STOCC) at GSFC, via the NASA Communications Network (Nascom) and SN. Emergency support is provided by the GN or DSN 26-m Subnet stations. The STOCC is comprised of the POCC. A description of the HST POCC is contained in Section 2, paragraph 2.2.2.

1.3.3.2

Science planning for HST operations will originate at the Space Telescope Science Institute (STScI). The monthly science plans of STScI will be developed into daily operations schedules after HST spacecraft operational requirements have been factored into the POCC schedule, and TDRSS support has been confirmed. It is possible for daily schedules and long-range observing plans to be interrupted for observation of targets of opportunity. These observations will still require the same preplanning and scheduling, but with much shorter turnarounds. The Level 1 requirement is 24 hours; however, the operational goal is 9 hours. The STScI will transmit spacecraft mission schedules and command loads to the STOCC.

1.3.3.3

For normal operations, all HST Observatory data (science and engineering) will be received via Nascom and SN. The data will be routed to the Sensor Data Processing Facility (SDPF) at GSFC and the HST POCC. The SDPF will capture all of the science data. The captured science data will be sent to the STScI within 1 day, with a minimal amount of data manipulation. In addition, the SDPF will provide a temporary storage of the captured data until receipt of the data is verified at the STScI. The HST POCC will receive HST data for real-time display and monitoring purposes. HST engineering data will be recorded and stored by the HST POCC for a limited period and stored in the Hubble Data Archive for the life of the mission.

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Figure 1-3. Mission Operations Ground System

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Figure 1-4. HST Ground System

1.3.3.4

The HST POCC will receive, record, process, and display all HST engineering data required to monitor the health and safety of the Support Systems Module (SSM), Optical Telescope Assembly (OTA), SI Command and Data Handling (SIC&DH), and the SI's. The HST POCC will generate, transmit, verify, and record all commands to the HST, and accept a daily mission input from the STScI. The SDPF will be included in the distribution of the NCC mission schedule to support the performance of the science data accounting function. The STScI may generate real-time HST command requests, as scheduled, to the POCC via the OPUS command interface.

1.3.3.5

The STScI will be responsible for obtaining, reviewing, and prioritizing observation proposals. It will provide long-range science planning, daily mission schedules and loads, and participate in real-time science operations; It will perform science data calibration, data analysis, science instrument trend analysis, science data archiving, and data distribution for the observers.

1.3.3.6

The mission operations approach is to maintain a balance between manual operations versus automation, software versus hardware, and ground software versus onboard software. The following are among the more significant operations guidelines:

    a.   Critical commands are provided with ground system interlocks to prevent inadvertent initiation.

    b.   Onboard automatic functions are provided with ground-commandable overrides.

    c.   Selection of redundant configurations are by ground command.

    d.   Housekeeping data are transmitted concurrently from all science instruments.

    e.   The Observatory maintains onboard closed-loop attitude control. Attitude is monitored in the STOCC via real-time telemetry.

    f.   Ground systems implementation and operations planning uses pre-planned operations, but the ground system will also be capable of supporting health and safety real-time operations.

    g.   Observatory design contains safe mode features to preserve the Observatory (without immediate ground intervention) in the event of spacecraft failures, and preserve the SI's in the event of certain SI C&DH failures.

    h.   Prepass operation planning uses computer aids to the maximum extent practical.

    i.   Principal planning and generation of mission schedules occurs during the 5-day work week.

    j.   The STOCC is manned 24 hours per day.

    k.   All HST engineering data received at the POCC and all spacecraft commands are recorded on a history tape.

1.4 Spacecraft Description

1.4.1 Hubble Space Telescope Observatory

The HST currently in orbit weighs approximately 24,973 lbs (11,328 kg) and is 53 feet (17.6 meters) long and 14 feet (4.3 meters) in diameter. The HST Observatory consists of a spacecraft and five SI modules. The spacecraft portion of HST described in this section and shown in Figure 1-1 is divided into three main systems: the SSM, the OTA, and the SIC&DH.

1.4.2 Support Systems Module

1.4.2.1 General

The SSM is designated to accommodate the SI's, the OTA, and the SIC&DH. It provides electrical power for the entire Observatory and the telecommunications link from the HST to all external contacts, including the TDRSS and the GN/DSN stations. The SSM subsystems consist of the Electrical Power Subsystem (EPS), Instrumentation and Communication (I&C) Subsystem, Data Management Subsystem (DMS), Pointing Control Subsystem (PCS), Thermal Control Subsystem (TCS), Safing Subsystem, and Structures and Mechanical Subsystem (S&M). The SSM is designed to allow in-orbit replacement of many components, including all of the SI's, by Space Shuttle Orbiter crew members.

1.4.2.2 Electrical Power Subsystem

The EPS consists of two solar array assemblies, six nickel hydrogen batteries, and the associated power control conditioning and distribution circuitry. The six rechargeable nickel hydrogen batteries each have a capability of 85 ampere-hours and are recharged by the solar array through Charge Current Controllers (CCC). There is one CCC dedicated to each battery, and each CCC monitors the terminal voltage and battery temperature in order to control the charge control relays within the Power Distribution Unit (PDU).

1.4.2.3 Instrumentation and Communication Subsystem

a. The I&C Subsystem provides temperature sensors and signal conditioning equipment, and onboard communication equipment required to receive commands from external sources (TDRSS, Space Shuttle Orbiter, DSN or GN) and transmit data to these external sources. The equipment includes transducers, transmitters, transponders, amplifiers, multiplexers, RF switches, and antennas.

b. Primary communication to the HST is accomplished through the TDRSS MA or SSA cross-support forward link using the Low Gain Antenna (LGA) system and the receiver portion of the MA transponder. The LGA system consists of two conical spiral antennas with a frequency range of 2100-2300 MHz (located at opposite ends of the HST) to provide approximately 95 percent spherical coverage. Communications from the HST are accomplished through the TDRSS MA and SSA return links using the HGA system during normal operations, and the LGA system during deployment, retrieval, and contingency operations. During contingency operations the LGA will provide the communications link via GN or DSN stations.

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Figure 1-5. Instrumentation and Communication Subsystem

1.4.3 Optical Telescope Assembly

1.4.3.1 General

a. The OTA is a 2.4-meter f/24 Ritchey-Chreti,n cassegrain telescope. The useable Field of View (FOV) of the focal plane has a 24.55-cm radius which corresponds to a radius of 14.0 arc min. on the sky. The focal plane of the telescope is divided among four axial scientific instruments, one radial scientific instrument, and three FGS's. The spectral range of the OTA extends from about 100 nm to about μm. It is expected that the OTA will be capable of detecting point sources of visual magnitude m_v 27, or brighter. The actuators are mounted on the rear of the primary mirror to adjust the figure of the mirror in orbit. The secondary mirror is adjustable in tilt, de-center, and de-space.

b. The subsystems of the OTA are the optics and the related structures and mechanism consisting of the Optical Control System (OCS), Actuator Control Subsystem (ACS), Electrical Power/Thermal Control Subsystem (EPTCS), and the FGS.

1.5 Scientific Instruments Description

The SI's consist of all individual scientific modules and selected components which are dedicated solely to the support of scientific instrumentation. The primary function of the SI's is to convert the OTA focal plane light energy into digital scientific information. After the SM2, SI's will consist of the following:

a. Wide Field/Planetary Camera II (WF/PC II).

b. Near Infrared and Multi-Object Spectograph (NICMOS).

c. Space Telescope Imaging Spectograph (STIS).

d. Faint Object Camera (FOT).

e. Corrective Optics Space Telescope Axial Replacement.

f. Fine Guidance Sensor (FGS).

Detailed SI descriptions, their principal investigators, and objectives are listed in

Table 1-2. Scientific Instrument Descriptions

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1.6 Launch Operations

1.6.1 General

This section describes those operations necessary for prelaunch checkout and launch support of the HST Servicing Mission. Additional information is provided in STDN No. 601/Space Shuttle Annex and 501-602/Space Shuttle Annex CL for the HST FSM and HST SM2.

1.6.2 Launch Vehicle

NASA will perform retrieval of the HST for scheduled on-orbit servicing using the Space Shuttle. Launch of the Space Shuttle with its complement of Space Support Equipment (SSE) is scheduled from the KSC. The physical layout of the SM Space Shuttle cargo bay for launch is shown in Figure 1-6.

1.6.3 Prelaunch and Launch Support Description

1.6.3.1 Prelaunch Activities

   a. Support from the SN is required during Space Shuttle/SSE integration activities prior to launch. The support required during these periods will consist of voice, command, and telemetry data lines, and full-time TDRSS services when required. All integration and testing will present the same operational interface to the Hubble Space Telescope Observatory Management System (HSTOMS) that will be in existence during the Servicing Mission.

   b. The POCC will provide hardware, software, and personnel support for all Servicing Mission pre-launch tests and simulations to run parallel with normal operational support. The POCC will ensure operational readiness of personnel and provide the hardware and software capabilities necessary to provide operations, fault isolation, and analysis support for Servicing Mission operations.

1.6.3.2 Prelaunch Integration Activities

Cargo Integration Test Equipment (CITE) integration and test activities will be performed with the SSE in the Vertical Processing Facility (VPF). After CITE Integration Verification Test (IVT) and End-to-End (ETE) testing is completed, the SSE will be transferred to the pad and installed in the Orbiter. Pad testing will include the IVT's and ETE testing.

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Figure 1-6. SM HST/Space Shuttle Bay Physical Layout

1.6.3.3 Prelaunch, Launch, and Servicing Mission Displays

During prelaunch, launch, and servicing mission, the SPIF provides Payload Parameter Frames (PPF) data and Orbiter engineering data. The data will be available to the project operations personnel via the Closed-circuit Television (CCTV) and ISP clients in the operation room. The data will also be transferred to the project for engineering analysis and for distribution to ISP clients. The OFLS and STScI will be operational to perform planning, scheduling of command generation, and attitude determinations/calibrations, in anticipation of and preparation for retrieval and redeployment activities. The capability will be provided to monitor the launch via a voice link to the JSC MCC. FDF will compute HST attitude based on Space Shuttle ancillary data and provide the results to the STOCC via CCTV.

1.6.4 Mission Simulation and Readiness Training Overview

1.6.4.1 General

HST SM pre-mission activities will include MSFC Neutral Buoyancy Simulator and JSC Weightless Environment Test Facility (WETF) EVA simulations with the Space Shuttle crews, the JSC/HST POCC Orbiter interfaces, and the SSE and ORU/ORI checkout procedures.

1.6.4.2 Simulations

The scope and sophistication of the simulations will progressively increase as system capabilities, resources, procedures and personnel requirements are defined. The simulations are designed to use, through standard scheduling procedures, simulation resources to the maximum extent possible, consistent with the needs and objectives of each particular simulation. The available resources include the SOC HST simulator, HST simulator, TDRSS simulation services, the Vehicle Electrical System Test (VEST) Facility, and the Software and Maintenance System (SAMS) and SPIF. HST simulation activities are primarily personnel-oriented, with emphasis on training, organizational interface validation, and operational procedures validation.

1.6.5 Launch Site Tests

The functional verification of HST/Shuttle SSE, ORU's, and ORI's is performed at KSC. The POCC is SM launch ready, with all software, hardware, and operations personnel in place and fully tested. POCC support of the functional verification is limited to the ETE testing and involves online and offline systems capabilities, as needed, to plan, schedule, and participate in the tests. A three shift, 24-hour/day schedule for operations personnel is in effect and continue for the life of the mission. The SOC, CITE, JSC MCC, associated RF equipment, and Portable Spacecraft Simulator (PSS) provide support to HST SM readiness testing at KSC VPF and launch complex. Command and telemetry interfaces are designated and are implemented to support project-defined requirements.

1.7 Servicing Missions

1.7.1 General

Periodic Servicing Missions (SM) will provide the capability to replace HST hardware to sustain the HST as a viable observatory throughout its 15-year mission lifetime. The decision to fly an SM will be made by NASA Headquarters, based upon recommendation of the HST Project and an assessment of the overall HST Observatory status. Several kinds of SM's are planned to keep the HST operating properly for an extended lifetime. Some are scheduled, and others are anticipated responses to contingencies that may never occur.

1.7.2 Scheduled Missions

Scheduled missions, or Launch on Need (LON), are those required for routine maintenance of the HST Observatory. They will occur at approximately 3-year intervals to replace components having limited lifetimes such as batteries, fine guidance sensors, and solar arrays. The specific tasks performed on each mission will vary depending on the status of the observatory's components.

1.7.3 Unscheduled Missions

Unscheduled missions are those required to provide a fast response to emergencies or malfunctions that are not part of the normal degradation of the observatory, such as loss of electrical power, command, or telemetry capabilities. System failures that jeopardize continued operations of the telescope, or data quality, may prompt a decision to launch a servicing mission between the scheduled 3-year service dates. Similarly, if malfunctions occur during the initial months after redeployment, or if the telescope's orbit later decays too much and a reboost is needed, interim SM's may be scheduled.

1.7.4 SM2 Mission Phases Overview

1.7.4.1 General

The SM commences with Orbiter launch, while HST SM operations activities begin with the configuration of the HST Observatory for Orbiter rendezvous, grapple, and berthing of the observatory on the Flight Support System (FSS). The crew will conduct four scheduled 6-hour SM EVA's to replace ORU's and ORI's. During each EVA, the STOCC actively assists servicing operations by commanding configuration changes and aliveness testing as needed, while the crew conducts ORU and ORI changeout, visual inspection of the observatory, and photo closeout. The STOCC also monitors observatory health and safety, and conducts brief post EVA checkouts of the newly installed units. If the SM calls for a reboost, it is conducted between or after the EVA's. More detailed information is available in the 501-602/Space Shuttle, Annex CL, HST (Revision 1).

1.7.4.2 Redeployment

The redeployment of the HST by the Orbiter is accomplished with the HST in a minimum power configuration with telemetry data through the Payload Interrogator (PI). Commanding of HST is also through the PI until a forward link through TDRSS is established. The Offline System (OFLS) is operational to process attitude sensor data for checking the HST attitude sensor polarities, gyro drift, and to validate HST attitude data prior to redeployment.

1.7.4.3 Servicing Mission Observatory Verification

After the on-orbit servicing operations and redeployment of the HST Observatory have been concluded, the Orbiter de-orbits and lands, concluding the SM for the Space Shuttle Program (SSP). HST operations will continue with the Servicing Mission Observatory Verification (SMOV) phase followed by a return to normal operations. During SMOV, the status and performance of all HST systems will be verified. Following the successful completion of SMOV, the HST will be made available to the scientific community for routine science operations.

1.7.5 Normal Operations

1.7.5.1

Normal science operations will start at the end of the SMOV. General observers are selected semi-annually by STScI on the basis of peer-reviewed research proposals. The STScI staff assists general observers in the detailed planning of their observing programs and have the responsibility for scheduling these observations, collecting the data, and transforming it into a form suitable for scientific analysis.

1.7.5.2

All observatory nominal and contingency real-time operations are controlled from the STOCC at GSFC. The HST STOCC represents the focal point for all mission operations, including vehicle command and control, determination of operating constraints and restrictions, vehicle health status and monitoring, and contingency control of the HST.

1.7.5.3

The HST SDPF receives science data from the spacecraft and forwards it to the STScI facility at the John Hopkins University in Baltimore, Maryland.

1.8 Mission Operations Support

1.8.1 SN Support Policy

1.8.1.1
Based on NASA Headquarters priorities and the most recent mission model and network evaluations, the HST support requirements are expected to be satisfied at least 95 percent of the time.

1.8.1.2
The SN recommends that forward-link command/tracking requirements be scheduled via SSA service whenever a concurrent SSA return support period is needed (either for 2255.5-MHz link science support, or 2287.5-MHz link housekeeping support in a contingency situation.

1.8.2 GN/DSN

The GSFC facilities at MIL and BDA, including 1024-kb/sec link capability, are the only GN sites. DSN support will consist of Madrid (RID), Canberra (CAN), and Goldstone (GDS).

1.8.2.1
The GN/DSN sites, scheduled for emergency only, have the capability of receiving and recording real-time engineering, 1024-kb/sec engineering dump, and NSSC-1 dump data. Subsequent postpass playback to the GSFC will be at a reduced rate (approximately 8:1). This mode will be used when scheduling permits. Refer to Table 1-4 for GN or DSN link requirements.

1.8.2.2
Real-time engineering telemetry links; i.e., 500 b/sec, 4 kb/sec, and 32 kb/sec will be supported by GN and DSN sites. Support from these facilities would, in a backup mode, be subject to the scheduling priorities established for emergency support. Emergency support by the DSN 26-m subnet facilities is required for the entire 15-year HST mission.

Table 1-3. GN or DSN Link Requirements

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1.9 MO&DSD Support

This section lists the nominal MO&DSD support that each STDN element provides for the mission. Specific operations scripts that define element activities and mission-specific inter-element procedures and configurations can be found in applicable sections of this document. Code 500 supporting elements include the following:

a. HST POCC (Section 2).

b. SPIF (Section 4).

c. NCC Operations (Section 5).

d. WSC (Section 7).

e. GN/DSN (Section 9).

f. Nascom Operations (Section 11).

g. FDF (Section 12).

h. SDPF (Section 13).

i. Testing (Section 14).

j. Data Management (Section 15).

k. Network or NCC/Station Interface Teletype Headers (Section 16).

l. Television Support (Section 17).

Table 1-1. HST Frequency Utilization Summary (1 of 2)

Frequency Transmitter Receiver	Emissions Characteristics	Modulation	Data	Frequency Authorization		Purpose and Remarks
				Requested	Approved	
2287.5 MHz	DG1-Mode 1 & 2	Staggered Quadriphase Pseudonoise (SQPN) modulation of two independent MA data channels: In-phase (I) and quadrature-phase (Q) (See Note)	Q channel Engineering data at 0.5, 4, or 32 kb/sec I channel Normally 4-kb/sec RT science, 4 kb/sec DF-244 dump, or 0.5, 4.0, or 32 kb/sec engr data	Yes	Yes	Mode 1 will simultaneously support 2-way coherent ranging, single or dual channels.
2287.5	Pulse Code	Biphase format	0.5, 4, 32			GN/DSN emergency

| MHz | Modulation (PCM)/ Phase Modulation (PM) | modulated directly on the carrier | kb/sec engineering, or 1024-kb/sec recorder playback | Yes | Yes | telemetry support, Space Shuttle Orbiter Frequency Modulation (FM) mode Ku-band channel 2 or 3 for relay through TDRSS and PSP bypass at 0.5-, 4.0-, or 32-kb/sec via Space Shuttle Orbiter. |

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Table 1-1. HST Frequency Utilization Summary (2 of 2)

Frequency Transmitter Receiver	Emissions Characteristics	Modulation	Data	Frequency Authorization		Purpose and Remarks
				Requested	Approved	
2255.5 MHz	DG2 SSA data channel	Binary Phase Shift Key (BPSK) direct modulation	Engineering Science Tape Recorder (ESTR), or Solid State Recorder PB; RT science or NSSC-I memory dump at 1024 kb/sec	Yes	Yes	SA return telemetry (TDRSS SSA return link only)
2106.4 MHz	QPSK	Command data module 2 added to I-channel PN code	125 b/sec or 1.0 kb/sec	Yes	Yes	TDRSS command support MA or SSA forward link
2106.4 MHz	PCM/PSK/PM	16-kHz command subcarrier or ranging tones	1.0 kb/sec	Yes	Yes	GN/DSN emergency command support, or Space Shuttle Orbiter PI forward link
Note						
Additional information on signal and emission characteristics may be found in the latest revision of the S*T-to-TDRSS ICD*, HST ICD-06. The Q-channel is used for engineering data. HST 4-kb/sec science or DF 224 memory dump data will be transmitted on the MA I channel. HST engineering data may be transmitted on						

either channel or simultaneously (including DF224 OBC dump). Mode 1 is two-way for ranging operations; mode 2 is one-way only.

Table 1-2 Scientific Instrument Descriptions

Instrument	Principal Investigator	Objectives
NICMOS	Roger Thomson, Steward Observatory	Near Infrared Camera and Multi-Object Spectograph - 2nd generation HST camera for 0.8 - 2.5 mm near-IR imaging. (Opens up new wavelength region.) Estimated lifetime of 4.6 years, but with possibility of refueling.
STIS	Bruce Woodgate, NASA/GSFC	Space Telescope Imaging Spectograph - 2nd generation HST spectrograph: UV echelles (R~ 24,000 and 100,000); UV-Optical, long-slit, first-order gratings (R~ 400 TO 14,000); and UV slitless prism (R~26 to 1000).
FOC	Dr. F. D. Macchetto, European Space Agency	To obtain imagery of very faint objects where an exposure time of many orbital periods may be required to accumulate sufficient photons for a satisfactory Signal-to-Noise (S:N) ratio. The image photon counting system used in FOC offers operational selection of a coronagraph, and an f/288 train in the primary f/96 system and a spectrograph in the f/48 system.
Astrometry	Dr. W. H. Jefferys, University of Texas	To collect astrometric data using the third Fine Guidance Sensor (FGS) while the other two FGS's are providing HST pointing stability. Some WF/PC data will be used to do astrometry. Astrometry targets will vary in magnitude from about $M_V=4$ to about $M_V=17$ and will normally be observed in groups to take full advantage of particular HST orientation.
COSTAR	Dr. J. Crocker, STScI	To provide an "unaberrated" beam to three of the axial instruments.

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Table 1-3. GN or DSN Link Requirements

Service	Data Type/Rate	Support
Telemetry		
S-band telemetry (2287.5 MHz)	Engineering real time at 500 b/sec, 4 kb/sec, or 32 kb/sec	All available GN and DSN stations that have a view of HST
	Onboard computer (DF-224) dumps	
	Engineering recorder playback at 1024 kb/sec and NSSC-1 RT dumps	
Tracking		
S-band Doppler and range tones	Two-way ranging and Doppler	Two-way Doppler concurrent with each forward link, ranging, time shared, and as available
	One-way Doppler	As available
Command		

S-band command (2106.4 MHz)	1 kb/sec	All available GN and DSN stations that have a view of HST

Document No.

Document No.

Section 1. HST POCC

1.10 POCC Operations

1.10.1 General

1.10.1.1

The HST PORTS Replacement System (PRS) support provides spacecraft control operations using an OLS string of computer systems, switches, and bus circuits to support real-time spacecraft control. MO&DSD ground system support operations will be accomplished using approved operations procedures and discrepancy reporting procedures. Planning information and command generation for onboard science instrument operations is supported.

1.10.1.2

The HST POCC supports engineering data management, including recording and manipulation functions for storage and transmission to recipients, and temporary storage, during which time spacecraft data will be available for replay. The POCC also maintains capabilities to communicate with external facilities to enhance the exchange of operational information during normal, emergency, and test conditions.

1.10.1.3

POCC Applications Software Support (PASS) provides capabilities in the areas of mission scheduling, command loading, attitude determination and sensor calibration, spacecraft subsystem monitoring, PASS data management, Astrometry and Engineering Data Processing (AEDP), and PASS operations support. PASS is loaded at the STScI and transmits command loads and mission schedules to the POCC. Subsystem performance analysis is performed using the OFLS, as requested by project operations personnel.

a.   PASS is a collection of software subsystems responsible for implementing capabilities in the POCC offline computer system.

b.   PASS responsibilities involve areas of scheduling, command loading, attitude and calibration computation, spacecraft subsystem monitoring, pass data management, and PASS operations support. Detailed PASS requirements are contained in the *PASS Functional Requirements Document (FRD) (CSC/SD-82/6069)*, which falls under HSTOMS and Hubble Space Telescope Project-Goddard (HSTP-G) configuration control procedures.

1.10.2 POCC Interfaces

The references for the MO&DSD ground system functional interfaces may be found in the *Hubble Space Telescope Observatory Management System (HSTOMS) Management Plan*, 510-951.1. The major POCC interfaces are described in the paragraphs that follow.

1.10.2.1 General

The HST POCC interfaces with external facilities via data lines and voice circuits to coordinate HST activities. The HST POCC online and offline systems, simulator system, and UPS will interface with external elements by a high-rate switch controlled by the Data Operations Control (DOC) facility. Voice circuits and keysets will be provided at all operational consoles for voice communications. Line tests and test message communications for many of the interfaces are supported. Refer to the SM Systems and Operations Requirements Document (SORD) for the functional interfaces that are needed to meet mission requirements.

1.10.2.2 STScI/POCC Interface

The POCC interfaces with the STScI via Closed Conference Loops (CCL) and commercial telephone communications. Data interfaces between the POCC and the STScI will be provided by data circuits for one-way and two-way data and information exchange via the online and offline systems.

1.10.2.3 POCC/NCC Interface

The POCC online and PASS offline systems, including PASS at the STScI, interface with the NCC to exchange schedules and status determination and service coordination messages. The online system interfaces via a 56-kb/sec simplex circuit (POCC to NCC) and a 224-kb/sec (NCC to POCC) circuit for the exchange of Operations Data Messages (ODM), acknowledgments, and Ground Control Message Requests (GCMR). The offline system interfaces with the NCC via the UPS. The UPS uses a 56-kb/sec circuit for exchanging schedule requests, data base queries, and acknowledgments. All exchanges will use 4800-bit block formats as defined in the *Data Format Control Document between the Goddard Space Flight Center Payload Operations Control Centers and the Network Control Center Data System*, 530-DFCD-NCCDS/POCC, and the *Interface Control Document between the Network Control Center Data System and the Network Control Center User Planning System*, 530-ICD-NCCDS/UPS, and HST ICD 18.

1.10.2.4 POCC/SN Interface

a. POCC voice interfaces with the SN via CCL's, Switching, Conferencing, and Monitoring Arrangements (SCAMA), and commercial telephone services.

b. The real-time data SN services are interfaced with the POCC via circuit-switched data circuits. All telemetry and command data are exchanged using the Nascom 4800-bit block formats for MDM transmission service and forward and return links.

c. All HST data rates (real-time and tape recorder playback) are accommodated; line outage recorder playbacks will be received, as needed, using additional circuits. The telemetry and command data are exchanged between the SN and OLS, via the POCC high-rate switch and Nascom.

1.10.2.5 POCC/GN/DSN Interface

The Nascom data and voice circuits interface the POCC with the GN/DSN for emergency support when needed. Telemetry and command data are exchanged using the Nascom 4800-bit block format for message switched data. Refer to HST ICD No. 18 and the *ICD Between JPL and SFC for GSFC Missions Using the DSN*, MDOD-1ICD/0182. (Refer to Appendix K for the HST).

1.10.2.6 POCC/KSC Interface

Launch site verification and confidence tests are supported by POCC data circuits that are in place for SN and GN support. Voice circuits to KSC use the keysets in the operations consoles. No unique POCC equipment is necessary.

1.10.2.7 POCC/JSC Interface

A communications interface capability (command, voice, and telemetry) with HST, via an interface at JSC, will be provided. The Shuttle/POCC Interface Facility (SPIF) will receive Space Shuttle engineering data for processing, electronic transfers, and CCTV displays of Space Shuttle ancillary data. HST engineering data is available through the Orbiter PI to PSP bypass and transferred to the POCC and SPIF via a JSC Payload Data Interleaver Serializer (PDIS) output on a JSC-to-GSFC MDM channel. Refer to the *Hubble Space Telescope Payload Integration Plan (PIP)*, Annex 5 (NSTS 14009, Annex 5).

1.10.2.8 PASS/FDF Interface

The FDF provides the POCC Off-line System (OFLS), including PASS at the STScI, with predictive and definitive orbit data and ephemerides. The information will be provided via a MODNET data circuit interface. The POCC transmits requests for this information to FDF via this circuit. During the Space Shuttle support phase of the HST mission, FDF will provide Space Shuttle attitude to the POCC via CCTV prior to HST release, based on Space Shuttle ancillary data recovered from SPIF. Refer to the *Interface Control Document Between Nascom and Flight Dynamics Facility*, Rev 2, STDN No. 220.2, and the *Operations Support Computing Facility (OSCF) to Space Telescope (ST) Payload Operations Control Center (POCC) Interface Control Document*, ST-ICD-32.

1.10.3 Spacecraft Control Data Base

The POCC contains a project-supplied data base in support of HST command and control operations. The POCC system uses the data base information to perform telemetry data handling and command activities. The data base is updated as required according to project inputs and serve as the cold-start default configuration for limit checking, telemetry decommutation, and normal data base functions. For more information on the Project Data Base (PDB), see ST-ICD-26.

1.11 Spacecraft Control Operations

1.11.1 Hardware

1.11.1.1
The POCC provides an OLS string to support real-time spacecraft control operations. The OLS string primarily consists of a Transportable Telemetry and Command (TTAC) system, Application Processor (AP), and up to 60 Micro-Virtual Interface Processors (MVIP). The OLS string is interconnected via an Ethernet Local Area Network (LAN) capable of handling intercomputer communications for throughput data processing; display; playback data handling; and command generation, transmission, and verification.

1.11.1.2
The OLS string, via a high-rate switch, is interfaced with external supporting elements for SM2 and nominal operations. An Ethernet LAN provides OLS string interface capabilities with the Project operation rooms for display and interactive keyboard communications with Project operations personnel. Ethernet is also used for OFLS operations displays and interactive communications.

1.11.1.3
The OLS string is a redundant system with failover capabilities. The TTAC, AP, and MVIP systems is backed up by failover systems. Overall system control, switching control, and system monitoring will be provided by a DOC facility for proper POCC coordination and use of resources to meet operational objectives.

1.11.2 HST Payload Operations Control Center

1.11.2.1 General

The HST POCC will contain five rooms specifically designated for Project operations: Mission Operations Room/Servicing Mission Operations Room (MOR/SMOR), Mission Support Room/Servicing Mission Support Room (MSR/SMSR), System Engineering and Evaluation Room (SEER), Engineering Support System (ESS) Room, and a Data Operations Control (DOC) area. Additional work areas will be provided in the equipment room and associated offices. Figure 2-1 shows the function and allocation for the various areas.

1.11.2.2 Mission Operations Room/Servicing Mission Operations Room Equipment

a. The MOR/SMOR will house the display and control equipment, including operator workstations directly associated with the operation of the HST spacecraft.

b. Two consoles remotely located at the STScI will be provided.

c. In addition, HST telemetry is available remotely via dedicated line, or Internet, to PC's, MAC's, or UNIX workstations.

Figure 1-7. POCC System Configuration and Equipment Allocations

1.11.2.3 System Engineering and Evaluation Room Equipment

The SEER provides for monitoring and analyzing spacecraft-unique parameters and functions.

1.11.2.4 Mission Support Room/Servicing Mission Support Room Equipment

The MSR/SMSR houses the display and control equipment (not including computers) directly associated with the planning operations of the HST spacecraft.

1.11.2.5 Engineering Support System Room

The ESS provides the HST project with an offline analysis capability. The ESS is used to perform both routine analysis and anomaly diagnosis.

1.12 Operations

1.12.1 Support Operations

1.12.1.1 General

The MO&DSD provides ground system (HSTOMS) support to the HST and oversee the ground systems via a configuration management plan. The configuration management plan identifies the documentation, hardware, and software under control of the HSTOMS Configuration Control Board (CCB). Anomalies or changes affecting the CCB-controlled elements will be identified, reported, investigated, and resolved by the HSTOMS CCB in accordance with defined procedures. The configuration management plan is in effect for all phases of HST support: prelaunch testing, launch and early orbit, routine mission operations, and ground/space refurbishment.

1.12.1.2 Hardware and Software Configuration Management

The MO&DSD ground system supporting the HST will be developed and maintained under the auspices of a project management plan. The scope of this plan is as follows:

    a.   Establishes a HSTOMS CCB for internal control of hardware, software, and procedural components of the POCC and PACOR.

    b.   Defines procedures for interfacing with the external CCB's: the HSTP-G CCB, the MO&DSD CCB, and the Office of Space Sciences CCB.

    c.   Defines procedures for logging and responding to Configuration Change Requests (CCR), software discrepancies, software enhancements, and associated documentation changes.

    d.   Defines HSTOMS internal interactions for identifying, reporting, and responding to hardware, software, and procedural changes.

    e.   Establishes a HSTOMS library and associated procedures for user access, documentation changes, and receipt of new documentation.

1.12.2 Scheduling

1.12.2.1 General

The PASS system, including PASS at the STScI, will receive Science Mission Specifications (SMS) from the STScI for input into the Scheduling System. The PASS System will accept the SMS TDRS requests and generate Schedule Add Requests (SAR) for throughput transmission via the UPS to NCC. Figure 2-2 defines the UPS interface operations, and Figure 2-3 defines the SN forecast schedule development. See Figure 2-4 for HST communication request processing. The POCC will exercise procedures for emergency support as documented in the *Operations Interface Procedures Between the Network Control Center and Spaceflight Tracking and Data Network Users*, 534-OIP-NCC/STDN Users, and *Goddard Space Flight Center Hubble Space Telescope Operations Control Center Interface Procedures with the Network Control Center*, STDN No. 509.2, for SN support; and Appendix K to the *ICD Between JPL and GSFC for GSFC Missions Using the DSN* (MDOD-1ICD/0182) and *Operations Interface Procedures Between the Spaceflight Tracking and Data Network Network Control Center and the Deep Space Network Network Operations Control Center*, STDN No. 508.3, for DSN support.

1.12.2.2 Internal POCC Data Processing (Trend Analysis)

The POCC OFLS including ESS and PASS will produce a dynamic and flexible telemetry data analysis system for performance monitoring, anomaly investigations, and trend evaluations. The OFLS capabilities may be used for continuous performance monitoring or anomaly investigation according to requests of project operations personnel. These include, but are not limited to:

    a.   Telemetry parameter selection.

    b.   Telemetry subset definition, compilation, and storage.

    c.   Telemetry data arrangement (into arrays) for analysis and display.

    d.   Analytical and report option selection by operator directives.

    e.   Selected engineering data analysis using specified techniques (e.g., Fourier analysis, computation of average, mean, standard deviation, etc.). Data selection will be performed by operator inputs of starts and stop times, with edit capabilities to delete unwanted data.

    f.   Selected report generation with output options including CRT displays, printer hardcopies, and temporary storage files.

1.12.3 HST Simulator Support

The POCC will support HST simulator activities by providing the hardware, interfaces, and operating system required for personnel training and ground system verification. The software provides simulated command responses via subsystem models data using POCC-housed hardware. The STOCC systems can be configured as independent online, offline, and simulator systems for realistic training and testing. Simulator support will be provided in the prelaunch phase and throughout the life of the mission. The HST simulator is located in the STOCC.

Figure 1-8.   UPS Interface Operations

Figure 1-9. SN Forecast Schedule Development

Figure 1-10. SN Service Request Processing

1.12.4 Support and Maintenance System

1.12.4.1
The MO&DSD will provide a non-collocated backup capability with the HST POCC Support and Maintenance System (SAMS). The SAMS will separate software development/ support functions from normal HST operations and provide a backup POCC facility for use in the event of a severe problem in the HST POCC. The SAMS facility falls under HSTOMS Configuration Management procedures.

1.12.4.2
The basic SAMS system will, at a minimum, provide a complete string of hardware to support spacecraft operations. To support this operations. To support this operation SAMS will have but not be limited to, the following hardware:

    a.   TTAC computer.

    b.   AP's.

    c.   Voice lines (SCAMA and CCL's).

    d.   MICROVIP workstations.

    e.   Nascom servers.

1.12.4.3
SAMS will be provided the following data/services to support their testing and alternate-POCC functions:

    a.   Four 1.544-Mb/sec full-duplex lines (two for spacecraft telemetry).

    b.   Seven 56-kb/sec full-duplex lines (four for spacecraft telemetry and command, one for communications between the UPS terminal and the NCC, one for communications with the FDF, and one for communications with Nascom Tech Control).

    c.   Three 56-kb/sec full-duplex Ethernet lines (one to LORAL, one to AlliedSignal, and one to CSC).

    d.   A fiber-optic Ethernet connection to the HST Ethernet LAN.

    e.   A Closed Circuit Television (CCTV) link.

    f.   A line carrying NASA-36 time.

    g.   Voice lines.

1.12.4.4
Further information may be obtained from the *SAMS Functional and System-Level Requirements Document*, LAS-SAMS-0035 and the *SAMS-to-Nascom* EC #541-6330.

1.12.5 Vehicle Electrical System Test Facility

1.12.5.1

The Vehicle Electrical System Test (VEST) Facility is a non-flyable but electrical replica of the HST flight vehicle, which together with its ground test control equipment, plays a vital role supporting the operations and maintenance of the HST Observatory. The VEST facility will be used for a variety of critical purposes, checkout of onboard and ground software, testing and verification of interfaces and functions of flight equipment intended for on-orbit installation, and the troubleshooting of on-orbit anomalies and problems.

1.12.5.2

While the design of the VEST will not preclude the capability for commanding and monitoring of the HST for purposes of engineering health and safety in the event of an emergency, there is no requirement that the VEST backup capability be tested. Further information may be obtained from the *Hubble Space Telescope Project Vehicle Electrical System Test Facility Requirements Document*, STR-23. Configuration management of the VEST hardware and software is accomplished through the Code 442 VEST Level IV CCB.

1.12.5.3

The VEST includes the following hardware:

    a.   HST electrical flight harness.

    b.   Various HST flight hardware and engineering models.

    c.   Various electrical ground support equipment.

    d.   MICROVIP workstations.

    e.   Application Processor.

    f.   TTAC hardware.

    g.   Various spacecraft simulator hardware, including the ESTIF.

1.12.5.4

The VEST will be provided the following data/services to support their testing and backup-POCC functions these interfaces are governed by the same ICD's as those governing the corresponding parts of the HST POCC itself:

    a.   Four 56-kb/sec full-duplex lines for test purposes and anomaly investigations.

    b.   Two 1.544-Mb/sec full-duplex lines for test purposes and anomaly investigations.

    c.   Voice lines.

    d.   A CCTV link.

    e.   NASA 36-bit timing line.

f.   LAN's connections to the STOCC and DSTIF.

Section 1. Command Management Facility

Command management support for the HST project is performed by the STScI POCC Applications Software Support (PASS) Operations (PASSOPS) activity. A brief description of the PASSOPS function is contained in Section 2, paragraph 2.1.1.3. A summary of command management support is discussed in paragraph 2.3.2.

Section 1. Shuttle/POCC Interface Facility

1.1 General

The SPIF at GSFC is the interface for GSFC POCC operations with the Space Shuttle, through the MCC at JSC and the LCC at KSC. Figure 4-1 illustrates the SPIF concept. The GSFC POCC has primary responsibility for all payload planning and operations. The SPIF will perform those functions which are unique to Space Shuttle support and common to all Space Shuttle flights supporting attached payloads and free flyers. During premission testing and flight operations, SPIF monitors the MCC/POCC interface, assists in fault analysis, and performs Space Shuttle-related functions.

1.2 Support Requirements

1.2.1 General

The interface control agreement document, POB-1/ICA/0188, defines the project inputs required by the SPIF online system and MCC simulator to support testing and mission operations. The *Operations Support Document*, POB-30 SD/0184, defines the capabilities and standard services provided by the SPIF, including premission activities and Space Shuttle operational support. HST requirements are documented in *MCC/JSC/Remote POCC Requirements Payload Operations Control Center Annex* (PIP Annex No. 5; JSC 14009, Annex 5).

1.2.2 HST Standard Service Requirements

The SPIF/STOCC will receive a composite data stream from JSC via GSFC Nascom to include real-time Payload Data Interleaver (PDI), Payload Parameter Frame (PPF), Calibrated Ancillary System (CAS), status, Orbiter attitude (real-time and planning), Orbiter state vectors (current and planning), Command Acceptance Pattern (CAP), and Real-time Command History (RTCH). Payload commands from the STOCC will be merged into the composite data stream and simultaneously routed to JSC. The SPIF will process the composite data stream (except PDI) to generate displays (via CCTV) and reports as required, and transfer a selected subset of data to the Flight Dynamics Facility (FDF). JSC data will be requested through MEWS.

1.2.3 HST Optional Service Requirements

1.2.3.1
For the HST servicing mission, the SPIF will reformat selected CAS and PPF data parameters for electronic transfer to the HST POCC. The backup SPIF system will be used to reformat selected CAS and PPF data for electronic transfer to the HST POCC, and will not be available for recording playback PDI.

Figure 1-11.   SPIF Concept

Figure 1-12. HST PDI Communication Interfaces for Service Mission

1.2.4 Operating Procedures

The following is a list of Space Shuttle/SPIF reference documents:

    a.   Operational Control Document (OCD)-2S-033-1, May 1987

        1.   Functional interfaces.

        2.   Operating procedures.

    b.   Operational Support Document (OSD)/POB-3OSD/0184, February 1986

        1.   Standard services.

        2.   Processing of data.

    c.   CAS Users Handbook/502-101.28, Revision 2 (March 1993), CAS Procedures/Services.

    d.   POCC/SPIF ICA, POB1ICA/0188 (July 1989), POCC/SPIF Interface Control Agreement.

    e.   SM SORD.

    f.   PIP Annex-3 and Annex-5.

Section 1. NCC Operations

1.1 General

Information in this section provides procedures which are necessary for support of the HST mission.

1.2 NCC Operational Interface Procedures for HST

1.2.1 General

The NCC provides management of resources for scheduling, controlling, and monitoring the performance of the STDN. This function includes coordinating the control of available network resources, schedule processing, conflict resolution, emergency scheduling, network testing, performance monitoring/fault isolation, acquisition data dissemination, and data base maintenance. In addition, the NCC is responsible for support of launch and real-time orbital operations, operational interfacing with HST, and ground configuration control. The HST/NCC interface is defined in STDN No. 509.2. The transmission of ISI 001 will initiate the mission status period and place the network on HST mission status. The network will remain on mission status until an ISI is sent to terminate mission status.

1.2.2 Scheduling Procedures

1.2.2.1
The interface for scheduling between the NCC and HST POCC is provided by NASCOM. Interface protocol is documented in the *Interface Control Document Between the NCCDS and the POCC*, 530-ICD-NCCDS/POCC. Interface message formats are documented in the *Data Format Control Document Between the GSFC Payload Operations Control Center and the Network Control Center*, STDN No. 230.1. The operations interface procedures are documented in Section 4 of the *Operations Interface Procedures Between the Network Control Center and Spaceflight Tracking and Data Network Users*, 534-OIP-NCC/STDN Users.

1.2.2.2
Scheduling of emergency support by JPL DSN will be according to Appendix K of the *JPL/GSFC Interface Control Document*. NCC procedures are contained in the *Operations Interface Procedures Between the Spaceflight Tracking and Data Network Network Control Center and the Deep Space Network Network Operations Control Center*, STDN No. 508.3. Updated Ground Network procedures are contained in the *Network Control Center (NCC) and Station Interface Procedures*, STDN No. 502.16 (Volumes 1 and 2); emergency support procedures are contained in 534-OIP-NCC/STDN Users (paragraph 6.6 and 5.2.2.3 of this document).

1.2.2.3 DSN Routine and Contingency/Emergency Support

a. Purpose. This procedure provides the method for scheduling HST spacecraft for DSN routine and contingency/emergency support for real-time and playback.

b. Participants

    1. NCC.

        (a) TM.

        (b) NM.

    2. STOCC.

    3. Ground Network Scheduling Office (GNSO).

    4. JPL Ops Chief.

    5. JPL TRACKON.

    6. Nascom Commgr.

c. Procedures.

    1. General Scheduling Procedures

        (a) Contingency/Emergency Support. In the event WSC or TDRS-East/TDRS-West experiences a extended failure or downtime that would prohibit direct command/telemetry support to HST spacecraft, the WSC would determine the extent of the outage and notify the NCC control center. NCC would notify HST project of the outage.

        (b) Routine Support. One contact at 4-week intervals at each of the 26-meter subnet stations as requested by STOCC.

    2. Routine and Emergency Support. Upon receiving a request for HST support, GNSO will request the following information:

        (a) Date and time of support duration (i.e., Julian day 100 1200-2000Z required).

        (b) Generic requirements (i.e., 1 contact every orbit above 15 degrees maximum evaluation).

        (c) Specific requirements (i.e., require CAN orbit 00123, GDS orbit 00124).

        (d) Special requirements (i.e., Project Data Formats [PDF] required for GN station or special Nascom configurations).

    3. STDN Routine and Emergency Support. Upon receiving a request for STDN support, NCC Scheduling will do the following:

        (a) For routine support, GNSO will schedule HST support based on requirements from STOCC.

(b) For emergency support, GNSO will schedule HST, based on requirements from either STOCC or the NM/TM.

4. DSN Routine and Emergency Support. Upon receiving a request for DSN support, NCC Scheduling will do the following:

(a) For routine support, GNSO will contact JPL scheduling and verbally confirm DSN support. GNSO will advise STOCC of DSN support being scheduled and ascertain that the type of support is sufficient.

(b) For emergency support, GNSO will contact JPL Ops Chief and advise them that there is a HST emergency support required from one of their DSN stations.

1.2.3 Coordination Procedures

NCC coordination procedures are also contained in Section 7 of 534-OIP-NCC/ STDN Users.

1.2.3.1 DSN Emergency Support Procedures

Emergency support resources from DSN are managed by the JPL Telecommunications and Data Acquisition (TDA) Office. Utilization of these resources will be coordinated in accordance with the JPL/GSFC ICD.

1.2.3.2 SN Fault Isolation

a. Purpose. This procedure establishes the guidelines for resolving problems which may occur during an event's support. Detailed procedures are contained in the *Network Operations Procedures For Network Control Center/Space Network Real-Time Fault Isolation*, 530-NOP-NCC/SN.

b. Participants

1. NCC.

(a) PA.

(b) TM.

2. WSC.

3. STOCC.

c. Procedure. The PA is responsible for coordinating fault isolation. The following guidelines are used:

1. The NM may at any time initiate an investigation of an SN problem so long as mission support is not affected.

2. The user may not troubleshoot a problem after it has been established as an SN anomaly unless requested by the NCC to assist in problem resolution. If the user is not willing to accept limited/degraded support, it will release the service to the NCC for problem resolution.

3. The NCC has the capability at all times to configure or reconfigure the network; however, changes to the SN configuration are not made during mission support without notifying the user.

4. Users will be advised only that service will be available/unavailable for the period in question. They will not be informed of any specific equipment/system failure.

1.3 NCC Data Base Information

1.3.1 Configuration Codes

A configuration code is a set of fixed and reconfigurable parameters which define a single service for a given SN user. HST configuration codes are contained in Tables 5-1 through 5-4. Configuration codes must be resident in the NCC and STOCC data bases prior to the start of interface testing. The HST MOSP is the controlling document for ST configuration codes. Any changes to these codes must be made in accordance with paragraph 5.3.2. Space Shuttle codes used during the SM may be referenced in 501-602/Space Shuttle (HST Annex).

1.3.2 Configuration Code Change Procedures

1.3.2.1 Purpose

When the HST Project determines a need to either change an existing configuration code or add a new configuration code to the existing codes, the procedures as documented in Sections 5, 6, 7, and 8 of the *Network Control Center Users Data Base Management and Control Plan*, STDN No. 910, will apply.

1.3.2.2 Participants

a. STOCC.

b. SN DBM.

c. MSM/DSM.

d. NM.

e. Affected elements.

1.3.2.3 Procedures

The HST Project will submit a Data Base Change Request (DBCR) to the MSM/DSM, who will verify that the request meets approved SN support commitments. The MSM/DSM will complete and forward the DBCR to the SN DBM containing the minimum information, as follows:

Data Base Change Request Format. User DBCR's will contain the following:

From: MSM/DSM (or user POCC for non-routine).

To: SN DBM.

Info: POCC (routine requests).
             MSM/DSM (non-routine requests).

Table 1-4. MA Return Link Configuration Codes

Table Not Available

Table 1-5. SSA Return Link Configuration Codes

Table Not Available

Table 1-6. Forward Link Configuration Codes

Forward Link Configuration Codes				
TDRSS Service	Forward Configuration Code	Initial Data Rate (bps)	Maximum Data Rate (bps)	Power Mode
MAF	A01	125	1000	
MAF	A02	1000	1000	
SSAF	H01	125	125	Normal
SSAF	H02	125	125	Normal
SSAF	H03	1000	1000	Normal
SSAF	H04	1000	1000	Normal
SSAF	H05	125	125	High
SSAF	H06	125	125	High
SSAF	H07	1000	1000	High
SSAF	H08	1000	1000	High

Table 1-7. Tracking Configuration Codes

Tracking Configuration Codes				
Configuration Code	TDRSS Service	Data Group	TRK TYPE	Notes
T01	MAF/MAR	1	2-WAY	MA XPNDR HGA EIRP
T07	SSAF/SSAR	1	2-WAY	MA XPNDR HGA EIRP
T09	SSAR	1	1-WAY	SSA XMTR
T15	MAR	1	1-WAY	MA XMTR HGA EIRP
T76	SSAF/MAR	1	2-WAY	X-SUPPORT MA XPNDR HGA EIRP
T86	SSAF/SSAR	1	2-WAY	I&Q Combined MA XPNDR LGA EIRP

BFEC Evaluation/Documentation Unit (EDU) ARO-4 (all requests).

NCC NM (all requests).

1. Subject: NCC data base change request.

2. SIC: _____ (Four numeric character SC identifier; refer to STDN No. 808).

3. Type Change: _____ (routine or non-routine).

4. Data base subset to be changed: _____ (e.g., configuration code, spacecraft characteristics record, Nascom scheduling parameters, etc.).

5. Configuration code, or prototype event ID with SUPIDEN: (refer to premission operation planning documents where applicable).

6. Parameters to be changed in NCC:

    A. Parameter name: _____ (e.g., maximum data rate, data channel configuration, receiver configuration, etc.).

    B. Channel: _____ (I, Q, 1, 2, or 3).

    C. Parameter value; from _____, to _____.

        (Note: repeat A, B, and C for each parameter to be changed.)

7. Requested implementation date: _____ (year, month, date time Z).

8. Additional clarifying remarks: _____ (as appropriate).

9. Release authority: _____

NOTE

Insert NA (not applicable) in items which do not apply.

1.3.2.4 Data Base Change Request

On receipt of a DBCR, the SN DBM will determine if other SN elements are affected by the change. If applicable, the SN DBM will issue a Data Base Change Instruction (DBCI) to the affected elements.

1.3.2.5 Verification and Acknowledgement

a. When an SN element receives a DBCI from the SN DBM, the affected element Data Base Controller (DBC) will initiate local processing procedures to implement and validate the data base changes.

b. Upon completion of implementation processing, the affected element will send a verification and acknowledgement message to the SN DBM. Initial acknowledgement may be sent verbally for real-time data base changes; however, written documentation must follow.

1.3.2.6 Data Base Change Notice Procedure

When the SN DBM has received acknowledgement of implementation and validation of data base changes from all affected elements, the SN DBM will transmit a Data Base Change Notice (DBCN) to the affected SN users and the MSM/DSM, indicating to all addressees that a requested data base change has been implemented.

1.4 Fault Isolation Procedures and Monitoring

1.4.1 Guidelines

1.4.1.1

The NCC will coordinate all operational real-time fault isolation when a SN problem is identified or suspected. Real time is defined as that period 5 minutes prior to scheduled event start time (T-5) to event termination.

1.4.1.2

The SN element discovering, or becoming aware of, a real-time operational problem, should immediately notify the WSC (CSC's).

1.4.2 Methodology

A step-type overview of procedures used for fault isolation can be found in 530-NOP-NCC/SN.

Section 1. White Sands Complex

1.5 General

1.5.1 Ground and SN System

The WSC ground station has the capability for constant communications with each of the orbiting TDRS's, as well as a full complement of simulation and verification equipment for all users. The Cacique (White Sands Ground Terminal Upgrade [WSGTU]) is a refurbished ground-based facility developed for NASA. The WSGT upgrade will support the continuing evolution of the SN. Cacique consists of two independent Space-to-Ground Link Terminals (SGLT); a standalone TDRS S-band Tracking, Telemetry, and Command System (STTCS), along with associated subsystems; and data recording and transport capabilities. Each SGLT consists of forward and return links/equipment chains to process command, telemetry, and tracking data for a TDRS and customer spacecraft simultaneously.

1.5.2 WSC Services

WSC will provide the forward link (for command), return link telemetry, and tracking services for the HST spacecraft. Table 1-4 defines services used in relation to the spacecraft operations, and Figure 1-2 shows the SN frequency links. Refer to Tables 5-1 through 5-4 for the operational codes.

1.6 SN Procedures

Procedures for defining and obtaining SN support and describing how a user flight project interfaces with functional elements of the GSFC MO&DSD are provided in the *Space Network (SN) User's Guide, and the Performance Specification for Services via the TDRS*, S-805-1, Revision B, which pertains to the operational aspects of TDRSS use.

1.7 Detailed Support Definition

1.7.1 TDRSS Service Use

1.7.1.1 General

HST uses MA and SSA TDRSS services to support the command, telemetry, and science data transfers. In addition, both coherent two-way range and Doppler (and noncoherent one-way Doppler) tracking services are used to support orbit determination, transponder frequency trend analysis, and other related functions. Configuration codes supporting service use are contained in Section 5 of this MOSP.

1.7.1.2 End-to-End Test Services

There are two types of End-to-End Test (EET) service capabilities available. The user has the capability of scheduling either type of EET service through the NCC. ODM's to the NCC and User Performance Data (UPD) to the POCC are available for both types of tests provided the test events are scheduled by the NCC.

a. The DIS EET provides for data to flow into and out of the ground terminal to simulate user forward and return services through TDRSS. For DIS EET test events, the simulated data stream paths must originate external to WSC. The following types of reconfigurations are available during DIS EET services: OPM-02, reacquisitions (for return services only); OPM-03, user reconfigurations; and OPM-11, Doppler Comp Inhibit Request.

b. The local EET is conducted locally at the ground terminal. PN test data streams are generated locally, flowed through the TDRSS system and terminated on site. The results of the LOCAL EET are verbally reported to the NCC. There are no reconfiguration capabilities during local EET services.

1.7.1.3 Multiple Access Services

HST requires 100 percent return link inview coverage for science, engineering, and memory dump (DF 224) data. The MA forward and return link parameters are listed in Tables 7-1 and 7-2, respectively.

1.7.1.4 S-band Single Access Services

SSA services will be scheduled to support the HST science and engineering data requirements. SSA forward and DG1 return link parameters are listed in Tables 7-3 and 7-4, respectively. Table 7-5 lists SSA 1-Mb DG2 return link parameters.

Table 1-8. MA Forward Link 2106.406 MHz; MAF Service

Command Channel	Ranging Channel	Power Ratio	Data Rate	Command Format	PN Code	Support Remarks
Command	Ranging	10 dB	125 b/sec	NRZ-L	Ø6	10 min per orbit (minimum)

Table 1-9. MA Return Link 2287.5 MHz (I/Q Channel Power Ratio 1:1)

TDRSS Service	I Channel	Q Channel	Modulation	Support Remarks
MAR DG1 Mode 1, 2	4-kb/sec science, or DF 224 memory dump RT data	4-or 32-kb/sec engineering RT	SQPN	100 percent in view (normal operations mode)
MAR DG1 Mode 1, 2	4.0-kb/sec engineering RT data	4.0-kb/sec engineering RT data	SQPN	Contingency support

Table 1-10. SSA Forward Link 2106.404 MHz

Command Channel	Ranging Channel	Power Ratio	Data Rate	Command Format	PN Code	Support Remarks
Command	Ranging	10 dB	1000 b/sec	NRZ-L	Ø6	Fifteen continuous minutes per visibility period (may be concurrent with SSA return link service).

Table 1-11. SSA Return Link 2287.5 MHz (I/Q Channel Power Ratio 1:1)

TDRSS Service	I Channel	Q Channel	Modulation	Support Remarks
SSAR DG 1 Mode 1, 2	0.5-kb/sec engineering-RT data	0.5-kb/sec engineering-RT data	SQPN	Deployment and contingency support
SSAR DG1 Mode 1, 2	4-kb/sec engineering-RT data	4-kb/sec engineering-RT data	SQPN	Contingency support
SSAR DG1 Mode 1, 2	4-kb/sec science or DF224 memory dump RT data	4/32-kb/sec engineering-RT data	SQPN	Minimal requirement

Table 1-12.   SSA Return Link 2255.5 MHz Parameters

TDRSS Service	I Channel	Q Channel	Modulation	Support Remarks
SSAR DG 2 (non-coherent)	1024-kb/sec science playback	NA	BPSK	20 minutes/VP* spread over 2 to 8 RT data contacts as requested by HST schedule (normal operations mode)
SSAR DG2 (non-coherent)	1024-kb/sec engineering, science tape playback	NA	BPSK	20 minutes/VP 3 times per day
SSAR DG 2 (non-coherent)	1024-kb/sec NSSC-1 memory dump	NA	BPSK	10 minutes per month
*VP = visibility period (exit ZOE to enter ZOE)				

1.7.1.5 Mission-unique Support

The SSA return equipment in the User Services Subsystem (USS) provides the capability to deinterleave/decode the 1/3 convolutionally encoded 1024-kb/sec data on the HST 2255.5 MHz link.

1.7.1.6 Pre-service Tests

A pre-service test will be automatically conducted on the chain of equipment selected for a given service, provided there is at least 3 to 5 minutes between the last use of the applicable service chain and the upcoming event start time that requests the same service chain of equipment. This pre-service test is conducted prior to the event start time for all service types within an event. The results of the pre-service test will be verbally reported to the NCC.

1.7.1.7 Scheduling TDRSS Services

All TDRSS user services provided through WSC are scheduled via a Scheduling Order (SHO) sent to the ground terminal by the NCC. SHO's are generated by the NCCDS based on service support requirements identified in SAR's submitted to the NCC by the POCC. These SARS's will identify by the order of configuration codes what services are required for a given event.

1.7.1.8 Data Quality Monitoring

Data Quality Monitoring (DQM) parameter requirements are incorporated in the SHO requirements sent to the ground terminal by the NCC. The DQM parameter requirements for HST which are used at WSC are contained in data base tables in the NCCDS.

1.7.1.9 Tracking Services

Tracking services are shown in Table 7-6.

Table 1-13. Tracking Services for HST (1 of 2)

See separate file: table7-6.doc -- Inserted here

Table 1-6. Tracking Services for HST (2 of 2)

See separate file: table7-6.doc -- Inserted here

Table 7-6. Tracking Services for HST (1 of 2)

TDRSS Service(s)	HST Link	HST Link Frequency	Data Type	Data Interval	Remarks
2-way Range and Doppler					
Multiple Access Forward (MAF)	MA XPNDR	2106.4 MHz	2-way range and Doppler	1 point/10 sec data with 10-minute intervals minimum	The collection of two-way range and Doppler tracking data will occur concurrent with the use of forward and return services, or command and telemetry operations, which will result in the three service combinations: a. MAF/MAR. b. SSAF/MAR. c. SSAF/SSAR.
Multiple Access Forward (MAR)	MA XPNDR	2287.5 MHz			
Or					
S-band Single Access Forward (SSAF)	MA XPNDR	2106.4 MHz	2-way range and Doppler	1 point/10 sec data with 10-minute intervals minimum	
MAR	MA XPNDR	2287.5 MHz	2-way range and Doppler	1 point/10 sec data with 10-minute intervals minimum	
Or					
SSAF	MA XPNDR	2106.4 MHz			The minimum requirement is to schedule/collect eight (8) each 10-minute

					intervals sets of data per day. The data are transmitted in TDM's from WSC to GSFC/FDD for HST orbit determination and tracking systems evaluation by FDD.
S-Band Single Access Return (SSAR)	MA XPNDR	2287.5 MHz	2-way range and Doppler	1-point/10 sec data with 10-minute intervals minimum	

Document No.

Table 7-6. Tracking Services for HST (2 of 2)

TDRSS Service(s)	HST Link	HST Link Frequency	Data Type	Data Interval	Remarks
			1-way Doppler		
MAR	MA XPNDR	2287.5 MHz	1-way Doppler	1 point/10 sec data with 5-min. intervals minimum	A minimum 5-min. interval data set is sent to FDD once per week to determine MA transponders' local (onboard) frequencies offset and drift rate, so the HST POCC can update the NCC data base to sustain good HST-TDRSS RF acquisition performance.
SSAR	MA XMTR	2287.5 MHz	1-way Doppler	1 point/10 sec data with 5-min. intervals minimum	
SSAR	SSA XMTR	2255.5 MHz	1-way Doppler	1 point/10 sec data with 5-min. intervals minimum	This is the same function as stated above, except the offset and drift rate is determines for the SSA transmitters.

1.7.2 Mission-Unique Support

1.7.2.1 Symbol Interleaving

Symbol interleaving of convolutional encoder symbols on the HST 2255.5-MHz link for 1024-kb/sec data is performed on the spacecraft. The data is 1/3-convolutionally encoded and interleaved. (See Figures 7-1 and 7-2.)

1.7.2.2 WSC Data Deinterleaving

WSC provides a Linkabit Viterbi deinterleaver/decoder for deinterleaving of data, which increases BER capabilities. (See Figure 7-3.)

Figure 1-13.   High Data Rate System

Figure 7-2. Periodic Convolutional Interleaving

Figure 7-3. (30,116) Periodic Convolutional Deinterleaving

Section 1. Ground Network/Deep Space Network

1.8 Ground Network Support

1.8.1 General

For simplification, this section will include support from the DSN in addition to the GN. Supporting stations will provide emergency orbital support as scheduled for the life of the spacecraft. Proficiency training with the DSN will be scheduled on an average of once every month when schedules permit.

1.8.2 Deep Space Communication Complexes Support

HST mission-unique equipment configurations and procedures are contained in this MOSP, and the DSN procedures are contained in the Deep Space Network Operations Plan (NOP).

1.8.3 DSN Support Configuration

1.8.3.1
The DSN support configuration is a hybrid of the SPC, Ground Communications Facility (GPC), Networks Operations Control Center (NOCC) systems, and the existing 26-meter systems.

1.8.3.2
The tracking data interface will be via the existing 26-meter data paths at the station from the MPA through the SPC to JPL. At JPL, the tracking data from the SPC will pass through the External Users Gateway (EUG) for transmission to GSFC FDF. The FDF will process HST tracking data and send IIRV through the Error Correction and Switching (ECS) subsystem to the Network Support Subsystem (NSS). The NSS will store the IIRV's until needed, and then forward the information to the 26-meter stations. Command data interfaces directly between the EUG and the station Command Processor Assembly via modem and 512-kb/sec data line from GSFC. An additional 224-kb/sec circuit is also available as a backup.

1.8.3.3
Monitor and Control data will be via the new systems where the NOCC system receives data from the various SPC systems, builds a composite monitor data block, and transmits it to the project through the EUG.

1.8.3.4
The telemetry data streams will be supported in two different manners. The downlink signal is received by the 26-meter antenna and the Multi-Function Receivers (MFR). The output of the MFR's will be patched to a set of 26-meter Bit Synchronizers. At this point, the telemetry data stream will take one of two routes depending on the data rate. The HST real time (.5, -4- and 32-kb/sec) data will be routed to the SPC telemetry processing equipment. The input to the SPC

will be through the Baseband Patch panel to the DSA. The DSA is modified to include a bit switch which will bypass the DSA functions to the rest of the telemetry processing equipment. The HST will be supported with this switch in the bypass position. The output of the DSA is sent to MCD, which will automatically pass the data stream through to the TCA. The TCA then packs the data into output DGIB blocks, time tags the data blocks, and outputs blocks to the SCP. The SCP will transmit the data to JPL in real time while recording the data on tape drives as back-up. Routing of data from JPL to the GSFC HST POCC is detailed in Section 11 of this document.

1.8.3.5

For the HST data rate of 1.024 Mb/sec, the data will be recorded on the station Communications Processor (CP) and stored on Exabyte tape drives or gigabyte disk drives for post-pass playback at a reduced rate to the HST POCC.

1.9 Station Support

1.9.1 General

Supporting stations will provide tracking, telemetry, and command support for HST as a scheduled by the NCC and JPL NOCC. Supporting stations will provide the following HST-unique support for emergency operations when scheduled:

    a.   Recording/Playback of Data. GN or DSN stations record the 1024-kb/sec engineering type recorder dump data and replay postpass to STOCC at a reduced rate (approximately 8:1) in accordance with the NCC general schedule.

    b.   Mission Preparation. The HST Service Missions launch count and early orbit support sequence will be supplied as a teletype or printed DCN to the TDRSS Network Operations Support Plan for the Space Shuttle Annex CL (HST FSM and SM2), 501-602/Space Shuttle Annex CL.

1.9.2 Station Operations

OPSR activities are conducted in accordance with *STDN Network Operations Procedures for Station Operations*, STDN No. 502.1, along with this MOSP. Station reporting is in accordance with *Network Operations Control Center and Station Interface Procedures*, STDN No. 502.16 and this MOSP. DSN Station Operation Procedures are contained in the Deep Space NOP.

1.9.3 Link Readiness Test

The Data Generator (DG) sequence 624.3 will output the Command Spacecraft Memory (CSM) engineering formats for all Prepass Readiness Test (PRT) activities with the DG/NCP or CPA interface enabled. The NCC general schedule reflects the formats to be supported for both PRT and real-time support.

1.9.4 Tracking Support

The GN and DSN 26-m subnet supports both coherent and noncoherent tracking operations to generate 2-way ranging and 1-way Doppler tracking data, respectively. Two-way ranging will not be scheduled to occur simultaneously with telemetry data acquisition. Figure 9-3 shows the typical ranging timeline.

1.9.5 Command Support

The GN stations will provide command support from station Acquisition of Signal (AOS) to station Loss of Signal (LOS). The DSN 26-meter subnet will provide command support within DSN radiation limit restrictions. These, in general, are 5.5 degrees at DSS 16/17, 5 degrees at DSS 66, and 6 degrees at DSS 46. Command activity is via the throughput mode. Command uplink and ranging modulation may be scheduled to occur simultaneously; however, the HST telemetry modulation must be turned off prior to enabling ranging modulation on the downlink.

1.9.6 GN OR DSN 26-M Subnet Voice Contingency Support

1.9.6.1 General

In the event of a voice outage with the STOCC, the station will continue with typical station support activities as defined in Table 9-1. At H-1, the NCPS or CPA will be configured for commanding. Stations will AOS the real-time or PB dump data stream at H-1. At LOS+1, all data experiences LOS. If voice communication is still out at this time, the GN/DSN 26-m subnet will send in a problem report in accordance with STDN No. 502.16. The DSN will support throughput commanding only.

1.9.6.2 Voice Outage Contingency

   a. In the event of a voice outage with the STOCC at any time between AOS minus 5 minutes and LOS, the station will continue with typical station support activities. At H-1, the NCPS or CPA will be configured for commanding. Stations will AOS real time or play back dump stream at H-1. The station will conduct operations (normal receive only) and no ranging. If ranging is in progress and voice is lost, ranging will cease.

   b. The STOCC will continue to command if data lines are up, so carrier should be brought up in accordance with paragraph 9.4.2.12. At LOS + 1, all data experiences LOS. If voice communications are still out at this time the GN/DSN 26-m subnet will send in a problem report in accordance with STDN No. 502.16.

   c. If initial voice contact is not established by Predicted AOS (PAOS) minus 5 minutes of a scheduled real-time pass, stations will support in accordance with this MOSP or applicable Pass Briefing Message (PBM) as defined in STDN No. 502.16, paragraph 2.19, and record all real-time and   playback data for possible playback at a later time.

1.9.7 DSN 26-M Subnet Support

The DSN 26-m subnet stations will not be required to support HST time delay measurements. The DSN 26-m subnet will support all other command, telemetry, and tracking requirements as defined in this MOSP.

1.9.8 STOCC

1.9.8.1 General

The STOCC is divided into two areas of responsibility: STOCC Control and ST DOC.

1.9.8.2 POCC Data Operations Center (ST DOC)

The ST DOC responsibilities are as follows:

    a.   Coordinates with NCC and Nascom to properly interface the GN with the STOCC for all scheduled support.

    b.   During initial interface, briefs station on support configuration requirements.

    c.   Conducts prepass interface tests with station, as required.

    d.   Participates in postpass debriefings and releases supporting station to NCC and Nascom.

1.9.8.3 POCC HST Operations (STOCC Control)

The STOCC Control responsibilities to station are as follows:

    a.   Conducts and completes the prepass interface with stations.

    b.   Conducts real-time spacecraft operations using station tracking, telemetry, and command resources.

    c.   Coordinates spacecraft tape recorder playback operations with the station.

    d.   Coordinates command operations with stations, as required.

    e.   Coordinates and directs ranging operations with the station.

    f.   Conducts a debriefing following each support period.

1.9.9 Link Controller Procedure

1.9.9.1 General

The Link Controller procedure is used in conjunction with STDN No. 502.1 and *Network Operations Procedures for Network Computer Systems*, STDN No. 502.5, to place the station equipment in the HST support configuration. Normally used source/destination codes are listed in Table 9-1.

Table 1-14. HST Destination Codes

Facility	MSB Code (Octal)	Hex
MIL (GN site)	001	01
BDA (GN site)	004	04
BLT (GN test site)	030	18
SOC (GN test site)	064	34
RID (DSN site, DSS 66)	366	F6
GDS (DSN site, DSS 16)	204	84
GD9 (DSN site, DSS 17)	333	DB
CAN (DSN site, DSS 46)	225	95
NOCC (JPL)	167	77
NCC	217	(Note)
SPIF/JSC (pair/caps/CMD's)	026/007	(Note)
SPIF/JSC (pair/caps/CMD's)	226/207	(Note)
HST real-time telemetry (56 kb/sec)	053	26
HST playback telemetry (224 kb/sec)	034	1C
STOCC OLS (GCMR's/ODM's)	113	(Note)
STOCC OFLS	077	(Note)
STOCC UPS	373	(Note)
HST CMD (56 kb/sec)	053 (source)	
Note Not for use by GN, DSN.		

1.10 Telemetry

1.10.1 General

This section defines GN and DSN 26-m subnet station telemetry equipment configurations and data handling requirements in support of HST spacecraft. Tables 9-2 and 9-3 contain 403 frame synchronizer manual setup instructions, and Table 9-4 the recorder configuration setup parameters.

1.10.2 Launch Support

The GN/DSN provides support to the Space Shuttle in accordance with *Network Operations Support Plan for the Space Shuttle Program*, STDN No. 601/Space Shuttle, and the MOSP for HST, STDN No. 603/HST.

1.10.3 Spacecraft Support

Supporting GN and DSN 26-m subnet stations receive, record, and process telemetry in the throughput mode for transmission to the STOCC at GSFC.

1.10.4 Receiver Configuration

1.10.4.1 General

Refer to paragraph 9.4.2.7 for the MFR configuration. Nominal settings are listed in the *STDN Network Operations Procedures for Unified S-band Systems*, STDN No. 502.4. The demod/bit sync/decom configuration and Monitor Model 329 PSK demod configuration are not applicable.

1.10.4.2 Bit Synchronizer

The station bit synchronizers are normally under software control. Manual configurations are as follows:

	Unit/Function	Indication/Setting
a.	Manual program	Manual
b.	Code type	Bi∅-L

Unit/Function	Indication/Setting
c. Loop 2	(for 317/330)
	3 (for 335)
d. Conv	NA
e. Bit rate	4.00×10^3 (PDF-A)
	3.20×10^4 (PDF-B)
	0.5×10^3 (PDF-C)
	4.00×10^3 (PDF-D)
	1.024×10^6 (PDF-E)
	1.024×10^6 (PDF-F)
	1.024×10^6 (PDF-G)
	0.5×10^3 (PDF-H)
	1.024×10^6 (PDF-K)
	1.024×10^6 (PDF-L)
	1.024×10^6 (PDF-M)
	1.024×10^6 (PDF-N)
	1.024×10^6 (PDF-O)
	1.024×10^6 (PDF-P)
f.	Manual/program Program

1.10.4.3 PCM Decom

Refer to the appropriate TESOC and Data Generator Sequence 624.3 for details.

1.10.4.4 Stripchart Recorders

Stations record received Automatic Gain Controls (AGC) on stripchart recorders in accordance with *STDN Networks Operations Procedures for Unified S-band*, STDN No. 502.4.

1.10.4.5 Calibration Procedures

Perform signal strength calibrations in accordance with STDN No. 502.2.

1.10.4.6 High-speed Data Transmission

The GN TCDS transmits data in the TCDS throughput block format and the DSN TCA/SPC system transmits data in the DGIB throughput block format to the STOCC.

1.10.4.7 Reports

A Telemetry Summary Report (TSR) is required from all GN stations. Refer to section 6 of this MOSP and to STDN No. 502.16 for format and header information.

Table 1-15. 403 Frame Synchronizer Manual Setup Instructions (Async)

See separate file: s9tables.doc -- Inserted here

Table 1-16.   403 Frame Synchronizer Manual Setup Instructions (Sync Monitor)

See separate file: s9tables.doc -- Inserted here

Table 1-17.   Recorder Configuration

T R K	MTR Type: WBMTR DSS No. 530 A and B Speed: 120 in./sec	M O D E
1	Command verification receiver video 16 kHz PSK subcarrier	Dir
2	Constant amplitude servo reference mixed with TLM mixer	Dir
3	2287.5-MHz receiver video, BiØ-L (500 b/sec / 4 kb/sec / 32 kb/sec)	FM
4	Receiver video (2287.5 MHz /1024 kb/sec BiØ-L)	Dir
5	Reconstructed video (1024 kb/sec, Biϕ-L)	Dir
6	NASA 36-bit BCD time code/1-kHz carrier	FM
7	Reconstructed video (500 b/sec / 4 kb/sec / 32 kb/sec, BiØ-L)	FM

1.11 Unified S-Band

1.11.1 General

Information in this section supplements the *Network Operations Procedures for the RER Upgrade System*, STDN No. 502.40, which is necessary for support of HST. Supporting stations listed in ISI 001 provide tracking, telemetry, and command support as scheduled.

1.11.1.1 Scheduling/Support Periods

Tracking requirements and support time frames are defined in the general station schedule in accordance with procedures contained in STDN No. 502.16.

1.11.1.2 Link Description (Downlink)

The downlink description is as follows:

    a.   Frequency: 2287.5 MHz.

    b.   Modulation: PCM/PM.

    c.   Bandwidth: +10 MHz.

    d.   Power: 5W nominal (3.9 W min, 6.3 W max)

    e.   Polarization: Left Hand Circular (LHC).

1.11.1.3 Modulation Indexes

    a.   Telemetry: 0.78 rad nominal ($\pm$0.28 rad).

    b.   Command: PCM/PSK/PM 0.78 $\pm$ 0.28 rad peak.

    c.   Ranging modulation (GSFC tones/PM, 500-kHz major tone):

        1.   Uplink: 0.5 rad peak/tone.

        2.   Downlink: 0.5 rad peak for single tone; 0.356 rad peak/tone for two tones (ranging without command); and 0.29 rad peak/tone for three tones (ranging with command).

1.11.1.4 Orbital Support

    a.   General. Normal orbital support will be via TDRS. Emergency GN/DSN support will begin upon notification from NCC. Supporting stations provide tracking, telemetry, and command support as scheduled by NCC. Required MFR outputs are routed to telemetry for processing, then transmitted to GSFC and STOCC.

    b.   Acquisition Data. Request mission acquisition data in accordance with procedures in STDN No. 502.16.

c. Tracking Data Requirements. Scheduled two-way Range and Range Rate (R&RR) data is transmitted in near real time to GSFC during ranging operations as conducted by

STOCC. During two-way passes, when the station does not range, stations will transmit low-speed tracking data in accordance with STDN No. 502.40 and Section 1 of this MOSP.

d. Recording Procedures. AGC stripchart recordings are required in accordance with STDN No. 502.40.

e. Data Recording. Configure and co-operate recorders in accordance with STDN No. 502.29 and STDN No. 502.40.

f. Reporting. Standard reporting is done in accordance with STDN No. 502.16. Sections 15 and 16 of this MOSP contain HST-unique header information.

1.11.1.5 Operational Support Procedures

a. Equipment Prepass Checklist. Complete the prepass checklist prior to the support interface with STOCC. Use the normal configuration listed in STDN No. 502.40 and the following mission-applicable settings:

b. MFR (1024 kb/sec)

Unit/Function	Indication/Setting
1. Frequency	2287.5 MHz
2. AGC speed	30 msec
3. IF bandwidth	6 MHz
4. Video bandwidth	3 MHz
5. TLM demod	Syn PM
6. ASL	Enabled
7. Tuning mode	AUTO
8. Loop bandwidth	1000 Hz; reduce after solidlock to 300
9. RER upgrade preset	24

c. MFR (0.5, 4, 32 kb/sec)

Unit/Function	Indication/Setting
1. Frequency	2287.5 MHz
2. AGC speed	30 msec
3. IF bandwidth	150 kHz
4. Video bandwidth	75 kHz

5. TLM demod   Syn PM

6. ASL   Enabled

Unit/Function	Indication/Setting
7. Tuning mode	AUTO
8. Loop bandwidth	1000 Hz; reduce after solid lock to 300 Hz (4/32 kb/sec)
	1000 Hz; reduce after solid lock to 30 Hz (0.5 kb/sec)
9. RER upgrade preset	23

d. Exciter Control

Unit/Function	Indication/Setting
1. Frequency	2106.4063 MHz
2. Mode select matrix	Mode 11 (ranging: 0.5; CMD: 0.78)
3. Loop bandwidth	Med
4. Modulation mode	PM
5. Sweep range	160 kHz (+ 80 kHz)
6. Sweep time	5 sec
7. Sweep rate	32 kHz/sec

NOTE

The sweep rate is 22.5 kHz/sec.

1.11.1.6 STDN Ranging Equipment

Unit/Function	Indication/Setting
a. Mod level	Set prepass in accordance with STDN No. 502.40
b. Demod gain	Fixed
c. Auto/Man	AUTO
d. VCO1/VCO2	VCO1 (RCP)/VCO2 (LCP)

NOTE

The HST is LCP.

1.11.1.7 Low Frequency Processor

Unit/Function	Indication/Setting
a. Receive frequency	2287.5 MHz
b. Acquisition mode	AUTO

1.11.1.8 Digital Processor

Unit/Function	Indication/Setting
Major range tone	500 kHz

1.11.1.9 Main Antenna Polarization Control

Unit/Function	Indication/Setting
a. A-LCP/B-RCP	Lit
b. A-RCP/B-LCP	Not lit

1.11.1.10 RER Upgrade Range Equipment

a. RE Slave Controller (Operations Stage)

Unit/Function	Indication/Setting
1. Preset	23
2. Equip configuration	Operations
3. Health status	Green
4. Setup/cont	M/M
5. Major tone	500 kHz

b. Setup Information

Unit/Function	Indication/Setting
1. Major range tone	ACQ Fast
2. Rate aid freq	2287.5
3. Demod type	
4. Demod gain	Fixed
5. Zeroset mode	Operator option
6. Calibration range	XXXX
7. Minor range tone seq	AUTO

Unit/Function	**Indication/Setting**
8. Demod phasing	Complete
9. Arc	Use
10. Preset	23

c. Exciter Setup

Unit/Function	**Indication/Setting**
1. Frequency	2106.4063 MHz
2. Loop bandwidth	MED
3. Modulation mode	PM
4. Sweep range	160 kHz (+ 80 kHz)
5. Sweep time	5 sec
6. Preset	23
7. Sweep rate	32 kHz/sec

1.11.1.11   Acquisition Source and Procedures

a. General. The HST transponder may be configured to turn on by spacecraft stored command, or by a contingency ground command. Normal two-way acquisition procedures, in accordance with STDN No. 502.40, are used when the HST spacecraft is configured in this mode. Carrier on/off times are normally AOS minus 1 minute/LOS plus 30 seconds, unless otherwise directed by STOCC. If stations are required to use one-way, three-way, or blind acquisition procedures, the STOCC will advise the station during the prepass briefing. One-way, three-way, and blind station acquisition procedures are contained in STDN No. 502.40.

b. Ranging Procedures. When STOCC directs the station to initiate ranging, the station commences automatic range acquisition in accordance with STDN No. 502.40. STOCC will direct the station when to cease ranging.

c. Contingency Procedures. Contingency procedures are coordinated with, and approved by, NCC prior to implementation.

d. Data Transmission Procedures. Transmit tracking data in accordance with STDN No. 502.40 and Section 1 of this MOSP as scheduled by the NCC.

e. Data Recording Procedures. Configure and operate recorders in accordance with STDN No. 502.40 and STDN No. 502.29.

1.12 Station Computer Systems

1.12.1 Data Processing

Stations configure a TCDS for GN and TCA for DSN as scheduled, to process HST telemetry and configure the Tracking Data Processing System (TDPS) tracking data transmission to GSFC. Refer to Tables 9-4 and 9-5 for appropriate formats and destination codes.

1.12.2 Supporting Stations

GN and 26-m stations (DSN) will support HST for emergency operations only, when scheduled during TDRSS service downtimes.

1.12.3 Documentation

Refer to *STDN Network Operating Procedures for Network Computer Systems*, STDN No. 502.5, and the appropriate Software Catalog for the Network (SCAN), STDN No. 504, in addition to this MOSP TCDS documentation.

1.12.4 Spacecraft Support

1.12.4.1 Equipment Configuration

GN stations will configure the TCDS systems, as scheduled, in accordance with the latest Software Support Instruction (SSI). See Figure 9-1 for the appropriate 4800-bit block format. See Figure 9-2 for the DGIB data block format.

1.12.4.2 Destination Codes/Characteristics

Normally used destination codes are listed in Table 9-1.

1.12.5 Real-time Tracking Data System Support

1.12.5.1 General

DSN supporting stations will use the Metric Pointing Assembly (MPA) to send tracking data to GSFC. Additionally, supporting stations receive acquisition data in the form of IIRV. GN supporting stations will use the Station Tracking Processor System (STPS) to send tracking data to GSFC. The acquisition data is processed on station to provide pointing data for the antenna systems. The STPS operational software (refer to the STPS users guide) is used to perform both of these functions. The system setup is described in paragraphs 9.5.5.2 and 9.5.5.3.

1.12.5.2 TDPS Configuration

Unit/Function	Indication/Setting
a. Program mode	Online
b. SIC/VIC	1446/01 (refer to note)
c. Low-speed tracking data	ON at AOS minus 30 sec; OFF at LOS
d. CRT summary	ON at AOS minus 30 sec; OFF at LOS
e. Tracking Data Router (TDR)	DD

NOTE

During noncoherent two-way orbital support, use a VID of 7.

1.12.5.3 Data Quality Monitoring

DSN stations will use a LMC to build a link that will provide telemetry data monitoring and status via the LMP per DSN NOP. Stations equipped with the SDS should use the DQM system to monitor the active data streams.

NOTE

The upconverted (8:1) PB formats, PDF E, G, N, and P, do not provide an adequate pattern for the DQM function; therefore, DQM setup/operation for these formats should not be attempted.

Table 1-18.   HST Data Characteristics and Mission Specifications

See separate file: s9tables.doc -- Inserted here

Document No.

Figure 1-14. Throughput Telemetry Message Format (DDPS)

Figure 1-15. DGIB Throughput Data Block Format

1.13 Command

1.13.1 Requirements

The NCPS is used in the throughput mode for commanding the spacecraft at GN stations. The DSN sites command interface is via the CPA.

1.13.2 Applicable Documentation

TBS.

1.13.3 Radio Frequency Parameters

RF parameters for HST are as follows:

    a.   Frequency: 2106.4 MHz.

    b.   Mod index: 0.78 + 0.28 radians peak.

    c.   Transmitter power: 1 kW (GN); 200 W DSS-17 (TWTA); 16W (DSN) 26m PA bypass support.

    d.   Polarization: LCP.

1.13.4 Command Description

1.13.4.1 Parameters

Command parameters are as follows:

    a.   Baseband modulation: PCM/PSK/PM, code type NRZ-L.

    b.   Subcarrier frequency: 16 kHz (PSK data synchronous with subcarrier).

    c.   Clock frequency: 1 kHz.

    d.   Clock/data phase angle: 0 degrees.

1.13.4.2 Throughput Command Format

The STOCC transmits 4800-bit block throughput command messages to GN/DSN in the format shown in Figure 9-3.

    a.   Command Format

        1.   Each command uplinked is initiated with a 144-bit preamble (of alternating 1's and 0's) followed by a 48-bit sync word, followed by one or more 48 bit commands, followed by a 32-bit postamble.

        2.   Command loads are organized in up to 64-word blocks where commands in any one block must all go to either the DMS or the SIC&DH stored command memories. (Each of these blocks has a ground-computed checksum as its last

word). Also, the command loads must be transmitted from the POCC in Nascom 4800-bit blocks.

Figure 1-16. Command Block Format

b. Sync Word. The sync word consists of 40 alternating logical 1's and 0's followed by the 8-bit code: 11110010, the last bit preceding this code being a logical zero. This sync word is recognized by the CDI which initiates processing of the commands. The commands themselves are formatted as 48-bit words; a command message consists of multiple 48-bit commands depending on the type of destination of the command. The details of these formats are contained in Figures 1-12 and 1-13.

1.13.5 Command Processing

1.13.5.1 Block Verification

Verification procedures for command blocks are as follows:

a. All command blocks transmitted from the STOCC must pass the following NCPS/CP throughput block verification checks before uplinking can occur:

    1. Good block error.

    2. Proper destination code.

    3. Correct source code (053^8) (MSB first).

    4. Correct spacecraft ID (060^8) (MSB first).

    5. Command execute field (000).

    6. Throughput command (105^8) message type.

    7. Legal data length.

b. Failure of any of the verification checks causes the block to be rejected. If all block verification checks are passed, the command format is ready for uplinking. In addition, the command block may be transmitted back to the STOCC as an echo check, with the NCPS/CP swapping source/destination codes in the Nascom header.

1.13.5.2 Uplink Formats

Uplink formats consist only of command data. The criteria for identifying the command data blocks are as follows:

a. Command Data Blocks. Blocks identified as command data are to be uplinked on a first-bit-in, first-bit-out basis; specific requirements of the message block header are as follows:

    1. Command execute field is 000.

    2. Data length is 272 to 4632 bits.

    3. Status of bit 82 is as follows:

        (a) If bit 82 is set to 1 in the received block, it and any preceding blocks received with bit 82 set to 0 are uplinked beginning with bit 145.

(b) If bit 82 is set to 0, the block is held in the NCPS/CP until any one of the following events causes the block to be uplinked:

    (1) Three seconds elapse before another command block is received.

    (2) A command block is received with bit 82 set to 1.

    (3) Five command blocks are received.

b. Execute Tone Blocks. Execute tones are not required for the satellite.

1.13.5.3 Test Message Blocks

Test message blocks received at the NCPS/CP are processed but not uplinked. Command echo blocks are retransmitted to the STOCC. Specific requirements of the test message block header are as follows:

a. Spare/command execute field is 0.

b. Data length is 0.

c. Command flag (bit 82) is 0.

1.13.5.4 Uplink Formats

Uplink formats consist only of command data. The criteria for identifying the command data blocks are as follows:

a. Command Data Blocks. Blocks identified as command data are to be uplinked on a first-bit-in, first-bit-out basis; specific requirements of the message block header are as follows:

    1. Command execute field is 000.

    2. Data length is 272 to 4632 bits.

    3. Status of bit 82 is as follows:

        (a) If bit 82 is set to 1 in the received block, it and any preceding blocks received with bit 82 set to 0 are uplinked beginning with bit 145.

        (b) If bit 82 is set to 0, the block is held in the NCPS/CP until any one of the following events causes the block to be uplinked:

            (1) Three seconds elapse before another command block is received.

            (2) A command block is received with bit 82 set to 1.

            (3) Five command blocks are received.

b. Execute Tone Blocks. Execute tones are not required for the satellite.

1.13.6 Network Command Processor System (NCPS)

1.13.6.1 Loading/Initialization

The throughput program is loaded and initialized in accordance with 534-SCAN-NCPS. The SIC typein for HST is 1446.

1.13.6.2 Pass Mode

On completion of the initialization mode typeins, the software puts the NCPS in pass mode. All commanding is throughput via analog to the stations RF systems. Upon initialization, the Polynomial Error Protection (PEP) and CMD echo functions will default to enable, and will remain enabled for support unless otherwise directed by the STOCC.

1.13.7 Command Processor Assembly

The JPL/DSN CPA will be initialized in accordance to the DSN NOP for HST..7   Acquisition Data Support

1.14 Acquisition Data Support

1.14.1 General

FDD generates and transmits weekly HST spacecraft acquisition messages to supporting stations. FDD will generate GN/DSN acquisition data based on a re-deployment vector received from JSC, approximately HST deployment minus 1 hour. FDD will transmit acquisition data based on this vector to the GN/DSN covering a 48-hour time period. All stations receive acquisition messages in the form of IIRV's.

1.14.2 Spacecraft Acq Messages

FDD generates and transmits daily HST spacecraft acquisition messages to supporting stations. Predicts and matrix printouts are delivered weekly to GN scheduling personnel, and weekly to the DSN. FDD procedures and capabilities are contained in Section 12 of this MOSP.

1.14.3 Vectors for DSN Scheduling

Vectors supplied to DSN Scheduling comply with JPL DSN 26-m scheduling, effective October 1, 1989.

Table 9-2. 403 Frame Synchronizer Manual Setup Instructions (Async)

Functio

n/ Address	PDF/Bit Rate						
	A/4 (kb/sec)	B/32 (kb/sec)	C/0.5 (kb/sec)	D/4 (kb/sec)	E/1024 (kb/sec)	F/1024 (kb/sec)	G/102 (kb/sec)
1	000	000	000	000	000	000	000
2	000	000	000	000	000	000	000
3	000	000	000	000	000	000	000
4	000	000	000	000	000	000	000
5	000	000	000	000	000	000	000
6	000	000	000	000	000	000	000
7	000	000	000	000	000	000	000
8	000	000	000	000	000	000	000
9	000	000	000	000	000	000	000
10	000	000	000	000	000	000	000
11	017	022	002	017	022	022	022
12	240	020	000	240	020	020	020
13	000	000	000	000	000	000	000
14	321	321	321	321	321	321	321
15	001	002	003	004	005	006	007

Table 9-3. 403 Frame Synchronizer Manual Setup Instructions (Sync Monitor)

Function/ Address	PDF/Bit Rate						
	A/4 (kb/sec)	B/32 (kb/sec)	C/0.5 kb/sec)	D/4 (kb/sec)	E/1024 (kb/sec) (note)	F/1024 (kb/sec)	G/1024 (kb/sec) (note)
1	372	372	372	372		000	
2	363	363	363	363		004	
3	040	040	040	040		317	
4	000	000	000	000		137	
5	377	377	377	377		000	
6	377	377	377	377		377	
7	377	377	377	377		377	
8	000	000	000	000		377	
9	330	330	330	330		130	
10	100	100	100	100		101	
11	007	006	003	003		006	
12	320	000	350	350		100	
13	000	000	000	000		000	
14	321	321	321	321		321	
15	000	000	000	000		010	

Note

PDF's E and G are 8:1 upconverted formats which do not provide a Frame Synchronization Word (FSW) pattern suitable for monitoring.

Table 9-5 HST Data Characteristics and Mission Specifications

PDF Format	HST Format	SC No. 43 Computer Format	PCM ID	SC ID 060₈ SIC 1446 Bit Rates (kb/sec) SC	CP-IN	CP OUT
A	AN, AF M	1	01	4.0	4.0	4.8
B	FN, FF	2	02	32	32	DDPS/SU E 33217.99 DSN DGIB 33449.477
	PN, PF	2	02	32	32	
	TN, TF	2	02	32	32	
	XN, XF					
	YN, YF					
	ZN, ZF					
C	C E	3 3	03 03	0.5 0.5	0.5 0.5	4.8 4.8
D	D	4	04	4.0	4.0	4.8
E*	(Note 1, 2, 3)	5	05	1024	128	DDPS/SU E 132,871.97 DSN DG1B 133,797.91
F*	(Note 1, 4)	6	06	1024	128	
G*	(Note 1, 2, 5)	7	07	1024	128	
H	S U	8	08	0.5	0.5	4.8
K*	(Note 1, 2, 6)	9	09	1024	128	(Same as E, F, G)

NOTE

1. GN/DSN engineering data playback to STOCC will be at reduced rate compatible with available site Nascom data lines, nominally at 8

2. All formats are 8-bit words, except E and G which are 64-bit words and K, which is 16 bits.

3. Engineering Tape Recorder (ETR) playback, format AN or AF, unconverted 8:1 prior to recording ; downlinked at 32:1 ratio (1024-kb/se

4. ETR playback, format FN, FF, PN, PF, TN, TF, XN, XF, YN, YF, ZN, or ZF, 32:1 ratio (1024-kb/sec), reverse direction.

5. ETR playback, format D, upconverted 8:1 prior to recording ; downlink at 32:1 ratio (1024-kb/sec), reverse direction.

6. NSSC-I memory dump, packetized, bank of 4096 memory locations dumped four times (refer to Note 1).

Section 1. Nascom Operations

1.15 General

This section provides the procedures and configuration information required for Nascom support of HST interfaces. When general procedures are applicable, they are referenced by document. Where specific procedures are required, they are contained within this section.

1.16 Nascom Resources

1.16.1 General

Nascom resources in support HST/TDRSS interfaces consist of voice, wideband, E-Mail, and type-1 data interfaces. Type-1 data between the WSC, the STOCC, and the Sensor Data Processing Facility (SDPF) is transported via the NASCOM MDM system. (See Figure 11-1 for an interface drawing and Figure 11-2 for HST NASCOM MA/SSA TDRSS interfaces.)

1.16.2 Space Network Type-1 Data Interfaces

1.16.2.1 General

Type-1 data interfaces and configuration codes between WSC, STOCC, SDPF, and Nascom (Bldg 14) are documented in NASA Communications Operating Procedures (NASCOP), Volume 2, STDN No. 540 and the Nascom Space Network Ground Segment Support Data Book, 542-016.

1.16.2.2 Source/Destination Channel ID Assignments

Nascom is responsible for assigning source/destination channel ID codes for NCC scheduling. The associated circuit designations assigned are for circuit interconnecting and troubleshooting coordination with Tech Control, STOCC, and SDPF. HST-assigned codes are listed in Table 11-1.

1.16.2.3 MDM Options

Nascom MDM options are selected, configuring the MDM according to the users' requests for the desired options. HST options contained in Nascom 542-016 and listed in Table 11-2 for quick reference.

1.16.2.4 WSC Assignments for HST

Nascom port assignments for HST are contained in Table 11-3.

Figure 1-17. Nascom Interfaces for HST TDRSS Support (1 of 2)

Legend

1. POCC Call Loop. General operations administration between POCC and the NCC on a full-period basis.

2. TDRS-1 (East COORD). Operations coordination loop between NCC and TDRSS Ops for the Eastern-located TDRS.

3. TDRS-2 (West COORD). Troubleshooting coordination between NCC and TDRSS Ops for the Western-located TDRS.

4. TDRS-3. Management scheduling coordination between NCC and TDRSS Ops.

5. TDRS-4. GRTS test/simulation coordination between NCC and TDRSS Ops (backup circuit for TDRS 1-3).

6. Computer Coordination. For coordination relating to state vectors, force models, etc.

7. NCC/Nascom Coordination (CCL-1). For general operations coordination, troubleshooting, and verbal relay from NCC of reconfiguration requests.

8. MDM Coordination Loop. For MDM network voice coordination between GSFC (Com Mgr, Tech Control, and MDM operator positions at JSC, WSC, and MSFC).

9. NCC Playback Coordination. For coordination of data playbacks.

10. NCC Operations Coordination. For coordination of NCC operations matters not normally involved on mission operations or test coordination loops.

11. Teletype Operations Facilities. Full-duplex eight-level circuitry provided for operational administration. Baud rates between 110 baud to 1200 baud provided as needed for each interface.

12. Type-1 Data Interfaces:

12A	-	Spacecraft command/telemetry.
12B	-	Tracking data.
12C	-	HST Science Data
12D	-	POCC/NCC Scheduling (UPS).
12E	-	NCC/WSC status/scheduling.

Figure 1-1. Nascom Interfaces for HST TDRSS Support (2 of 2)

Figure 1-18. HST MA/SSA TDRSS Interfaces

Table 1-19. Type-1 Data Interfaces for STOCC

Destination Channel ID	Assignment	Circuit Designation
HST Forward Link (Send)		
C01	RTC (RTC-6)	ST701
C02	MAF/SSAF sim	ST714
C03		
C04	MAF/SSAF	ST713
C05	SSAR Q CH sim (sim1)	ST715
C06	MAR I CH sim (sim 2)	ST716
C07	UPS	ST702
C08	HST sim, 56-kb/sec TLM	ST705
C09	GN CMD (STO-2)/TLM	ST706
C10	FDF ACQ Data (STO-1)	ST703
C11	GN P/B Bu/CMD (ST03)	ST730
C12	Spare	ST731
Destination Channel ID	**Assignment**	**Circuit Designation**
HST Return Link (Receive)		
C51	RTC	ST701
C52	MAR Q Chan, P/B or Sim (MSFC TLM)	ST712
C53		
C54	MAR/SSAR I CH TLM 2	ST708
C55	MAR/SSAR Q CH TLM 3	ST709
C56	SSAR I CH TLM 1 (1.024 Mb only)	ST707
C57	SSAR Q CH P/B (TLM 4)	ST710
C58	MAR I CH P/B (TLM 5)	ST711
C59	UPS	ST702
C60	HST sim 56-kb/sec TLM	ST705
HST Return Link (Receive)		
C61	GN RTN (STO-2)	ST706
C62	Orbit Data (STO-1)	ST703
C63	GN P/B Bu/CMD (ST03)	ST730
C64	Spare	ST731
D74	MAR/SSA I CH R/T	ICLU23-24
D86	SSAR I CH 1024-kb/sec	ICLU23-25

Table 1-20. Nascom Parameter Record for HST SIC 1446 (1 of 5)

Multiple Access Forward (MAF)		
SIC: 1446		
	GSFC	WSC
	ITU	OTU
Port ADDR	Open (Note)	Open (Note)
ITU/OTU No.	Open	Open
CH ID/DSID	00	00
Enabled	Yes	Yes
Blocked	Yes	No
Modify Header	No	
Time Out	No	
Time Tag	No	
Internal Clock		Yes
Clamp Clock		No
Clock Tracking		No
CAB Enabled		No
Frequency	56 kb/sec	125 b, 1000 b/sec
SCID	C04	
DCID		VAR
POCC I/F	ST713	
DMS	151, Var F	
Note Open scheduling is utilized. PA's 0101-0103 may be scheduled to support this service.		

Table 1-2. Nascom Parameter Record for HST SIC 1446 (2 of 5)

Multiple Access Return (MAR)				
SIC: 1446				
	WSC I CHAN ITU	WSC Q CHAN ITU	GSFC I CHAN OTU	GSFC Q CHAN (Note 1) OTU
Port ADDR	0139	0140	0139	0140
ITU/OTU No.	039	040	039	040
CH ID/DSID	Note	Note		
Enabled	Yes	Yes	Yes	Yes
Blocked	No	No	Yes	Yes
Modify Header	No	No		
Time Out	Yes	Yes		
Time Tag	No	No		
Internal Clock			Yes	Yes
Clamp Clock			No	No
Clock Tracking			No	No
CAB Enabled			Yes	Yes
Frequency	Note	Note	56 kb/sec	56 kb/sec
SCID	060	061		
DCID			C54	C55
POCC I/F Chan			ST-708	ST-709
DMS			39, 164R	40,165,20R

Note

Config Code	Chan/ DSID I/Q Chan	Data Rate (kb/sec)				DCID	
		Initial		Maximum			
		I Chan	Q Chan	I Chan	Q Chan	I Chan	Q Chan
B01, B04,B08	/56	0.5	0.5	4	4		
B02, B05B09,C12	54/54	4.0	4.0	4	32		
B03, B06,B33,B10	5A/54	4.0	4.0	4	32	D74	

B40						
B07	5A/54	4.0	4.0	4	4	D74
B11,C01, C02	54/55	4.0	32.0	4	32	
B12,C03C 05	5B/54	4.0	4.0	4	32	D74
B14,C04C 08	5B/55	4.0	32.0	4	32	D74
B13,C06C 07	5A/55	4.0	32.0	4	32	D74
C09	/56	0.5	0.5	32	32	D74
C10	/56	4.0	4.0	32	32	
C11	/54	4.0	4.0	32	32	

Table 1-2. Nascom Parameter Record for HST SIC 1446 (3 of 5)

S-band Single Access Forward (SSAF)		
SIC: 1446		
	GSFC	WSC
	ITU	OTU
Port ADDR.	Open (Note 1)	Open (Note 1)
ITU/OTU No.	Open	Open
CH ID/DSID	00	
Enabled	Yes	Yes
Blocked	Yes	No
Modify Header	No	
Time Out	No	
Time Tag	No	
Internal Clock		Yes
Clamp Clock		No
Clock Tracking		No
CAB Enabled		No
Frequency	56 kb/sec	Note 2
SCID	C04	
DCID		Var
POCC I/F	ST713	
DMS	151, Var F	

Note 1: Open scheduling is utilized. PA's 0104-0109 may be scheduled to support this service.

Note 2:

Config Code	Data Rate (/sec)	
	Initial	Maximum
H01, H02, H05, H06	125 b	125 b
H03, H04, H07, H08	1 kb	1 kb
H11, H12, H15, H16	125 b	125 b
H13, H14, H17, H18	1 kb	1 kb

Table 1-2. Nascom Parameter Record for HST SIC 1446 (4 of 5)

Function	Indication			
	S-band Single Access Return (SSAR)			
SIC: 1446				
	WSC I CHAN ITU	WSC Q CHAN ITU	GSFC I CHAN OTU	GSFC Q CHAN OTU
Port ADDR.	Open (Note 1)	Open (Note 1)	Open (Note 1)	Open (Note 1)
ITU/OTU No.	Open	Open	Open	Open
CH ID/DSID	Note 2	Note 2		
Enabled	Yes	Yes	Yes	Yes
Blocked	No	No	Yes	Yes
Modify Header	No	No		
Time Out	Yes	Yes		
Time Tag	No	No		
Internal Clock			Yes	Yes
Clamp Clock			No	No
Clock Tracking			No	No
CAB Enabled			Yes	Yes
Frequency	Note 2	Note 2	Note 2	56 kb/sec
SCID	Var	Var		
DCID			Note 2	C55/H52
POCC I/F CHAN				ST-709
DMS			Var, Var	46, 165, 20R
Note 1: Open scheduling is utilized. PA's 0141-0152 may be scheduled to support this service.				
Note 2: HST SSAR Assignments:				

Config Code	Chan/ DSIDI/ Q Chan	Data Rate (kb/sec)				POCC/I/F	OTU Freq
		Initial I Chan	Q Chan	Maxim um I Chan	Q Chan	I Chan	I Chan
I01	5A/	1.02 Mb		1.024 Mb		C56/D86	1.54 4 Mb
I02	5B/	1.02		1.024		C56/D86	1.54
I03	5C/	1.02		1.024		C56/D86	1.54
I04	57/	1.02		1.024		C56/D86	1.54
I07, J02, L04	54/54	4k b	4 kb	4 kb	32 kb	C54	56 kb
I08, J03	5A/54	4k b	4 kb	4 kb	32 kb	D54/D74	56 kb
I09	/56	4k b	4 kb	32 kb	32 kb		56
	5D/	1.02	1.024M	1.024		C56/D86	1.54
	/56	4 kb		4 kb	4 kb		56
J04, K03	54/55	4 kb	32 kb	4 kb	32 kb	C54	56 kb
J06, J07	5A/55	4 kb	32 kb	4 kb	32 kb	C54/D74	56 kb
J08, J09	5B/55	4 kb	4 kb	4 kb	32 kb	C54/D74	56 kb
K01, K02	5B/55	4 kb	32 kb	4 kb	32 kb	C54/D74	56 kb
L22	/56	500 b	500 b	32 kb	32 kb		56
L23	/54	4 kb	4 kb	32 kb	32 kb		56
I24	7F/	1.02		1.02		C56/D86	1.54

Document No.

| I25 | 80/ | 1.02 | | 1.02 | | C56/D86 | 1.54 |
| I26 | 7E/ | 1.02 | | 1.02 | | C56/D86 | 1.54 |

Table 1-2. Nascom Parameter Record for HST SIC 1446 (5 of 5)

HST Type-I Playback from WSC to GSFC		
SIC: 4625		
	WSC ITU	GSFC OTU
Port ADDR.	Note 1	Note 1
ITU/OTU No.	Note 1	Note 1
CH ID/DSID	00	
Enabled	Yes	Yes
Blocked	Yes	Yes
Modify Header	No	
Time Out	No	
Time Tag	No	
Internal Clock		Yes
Clamp Clock		No
Clock Tracking		No
CAB Enabled		Yes
Frequency	56 kb/sec Note 3	1.544 Mb/sec
SCID	Note 1	
DCID		Note 2

Note 1:

Playback Channel	SCID	ITU/OTU	Port Address
2	G10	092	0192
3	G11	093	0193
4	G12	094	0194

Note 2: Assigned in real time with coordination between Commgr and the POCC.

Note 3: For LOR playback of 1.024Mb science data, set frequency of ITU at 1.065 Mb/sec.

Table 1-21. WSC Assignments for HST

Forward Link			
Assignment	Port Address	SCID	Circuit
MAF/SSAF	0114	C04	ST-713
Return Link			
Assignment	Port Address	SCID	Circuit
MAR/SSAR "I" CH TLMMAR/SSAR "Q" CH TLMSSAR I CH TLM (1024KB)	0215021602 30	C54C55C5 6	ST-708ST-709ST-707

1.17 Resource Scheduling Procedures

1.17.1 General

Voice and teletype circuits are provided on a full-period basis and are available for activation/use procedurally without a specific scheduling input to Nascom. All Space Network data services provided will be scheduled by the NCC in accordance with the operations concepts in *Space Network Operations Policy*, STDN 119, *Interface Control Document between the NCC and the Nascom Control and Status System*, STDN 220.9, *Operations Interface Procedures between GSFC NCC and the NASA Communications Operating Procedures* (NASCOP) 542-006, Volume I and II.

1.17.2 Scheduling by NCC for Real-Time Type-1 Data Interfaces

1.17.2.1 Scheduling/Reconfiguration Messages

The NCC sends scheduling and reconfiguration messages to the Control and Status System (CSS) for events which involve data flows. The CSS will configure the MDM at GSFC to support all HST services that are schedulable by the NCC. The CSS will configure the MDM at WSC. (Refer to Section 6.) The CSS will not configure command echoes, type-1 playbacks, full period MDM configurations, and special mission configurations.

<div align="center">NOTE</div>

> The CSS will not accept an Nascom Event Schedule (NES) where either a source or destination channel interface is scheduled for reuse sooner than 16 seconds after termination of any stream (using either of two interfaces).

1.17.2.2 Advance Schedule Transmission

Nascom will initiate the transmission of an advance schedule to WSC. These messages are E-mailed contain event schedule and cancellation information. This information may be used by MDM operators to manually configure Nascom equipment. Procedures are contained in the *NASCOM Communications Division Control and Status (CSS) User's Guide*, 541-019.

1.17.2.3 CSS/NCC Scheduling/Status Failure

In the event of a CSS/NCC scheduling/status failure, NCC will update schedules verbally to Nascom, who will manually configure the required configurations.

1.17.3 Scheduling by NCC of Nascom for TYPE-1 Playback Data (LOR)

1.17.3.1
The CSS will not configure MDM systems to support SN playbacks scheduled by NCC. All playback MDM configurations will be established manually at each MDM location.

1.17.3.2

Refer to paragraph 5.2.3.10 for message formats.

1.17.3.3

Verbal requests from NCC to the COMMGR should include as a minimum:

    a.   PB start/stop time.

    b.   PB data rate.

    c.   PB source.

    d.   Original start/stop time.

    e.   Original source/dest.

    f.   Original data rate.

Section 1. Nascom Operations

1.18 General

This section provides the procedures and information pertaining to GSFC's FDD operations for the HST mission support. FDD support includes the following:

a. Orbit analysis and planning.

b. Metric data capture.

c. Orbit determination and ephemeris generation.

d. Trajectory planning.

e. Scheduling aids.

f. Ephemeris data.

g. Network calibration.

h. Acquisition data generation.

i. Space Shuttle data processing.

j. Local oscillator frequency determination.

k. HST earth/moon shadow prediction.

1.19 SM Prelaunch Phase

1.19.1 Premission Planning Data

1.19.1.1 General

The FDD will generate both SN and GN premission acquisition data, as necessary, to support mission operations with the HST POCC and network, and verify operational acquisition data generation procedures for HST servicing mission support. This category also includes the generation and transmission of prelaunch nominal acquisition data used in scheduling project and network resources during the launch, retrieval, and redeployment.

1.19.1.2 GN/SN Acquisition Data Computation

a. FDD will generate nominal GN and SN acquisition data based on redeployment vectors that are received from the HST project. The acquisition data will be transmitted to the GN no earlier than deployment minus 7 days and no later than deployment minus 5 days.

b. The SN acquisition data will be transmitted at approximately redeployment minus 1 day. This data will be updated in real time based on an updated deployment vector(s) received electronically from JSC.

1.19.1.3 Premission Support Requirements

In order to meet the premission support requirements, FDD will receive the following elements from the project no later than deployment minus 1 month:

a. Redeployment vectors for HST to include all contingencies as well as the nominal injection opportunities.

b. The final complement of GN/DSN/SN elements that will be supporting HST during the retrieval, repair, and redeployment phases.

c. Support timelines.

1.19.2 Scheduling Aids

1.19.2.1 General

FDD generates scheduling aids in the form of spacecraft view period information; i.e., Predicted Site Acquisition Tables (PSAT). In addition to the view period information, the scheduling aids provide certain view period characteristics such as sun interference and RF interference constraints. The scheduling aids will be provided to the HST project by launch minus 2 weeks.

1.19.2.2 Prelaunch

Prelaunch scheduling aids for HST include the following:

a. PSAT's provide predictive view period information for HST for each TDRS as well as for the GN and DSN elements. The standard PSAT data include spacecraft orbital event data associated with orbit day, orbit night, and periods of sun interference. The prelaunch PSAT will span the 2 weeks beginning at redeployment.

b. FDD will provide ephemeris data to PASS for each TDRS and to HST to aid in event scheduling. The prelaunch TDRS ephemeris data will span 7 weeks.

1.19.2.3 Scheduling Aids Computation

FDD will provide the following scheduling aids to the support elements according to the indicated support elements. This data will be provided by launch minus 2 weeks.

	Support Element	Product
a.	NCC Scheduling	Ground trace
		Pass summary
		PSI tape
b.	HST POCC	TDRS ephemerides PSAT

c. NCC	Ground trace
	Pass summary

1.19.2.4 Scheduling Aids Support Requirements

In order to meet scheduling aids support requirements, FDD will receive the following elements from HST project no later than redeployment minus 1 month:

a. Redeployment vectors for HST to include all contingencies.

b. The final complement of GN/DSN/SN elements that will support the HST during retrieval, servicing, and redeployment phases.

c. Support timelines.

1.19.3 Orbit Determination/Ephemeris Generation

The FDD will generate all ephemerides necessary to support prelaunch simulations and verify operational orbit determination procedures for the HST servicing mission.

1.19.4 Tracking Data Evaluation

FDD will evaluate tracking data received during prelaunch simulations as required for individual tests.

1.19.5 Vector Management

Procedures for SN acquisition of the HST spacecraft, including contingency cases have been developed and tested.

1.19.6 Mission Analysis

FDD will perform mission analysis and orbit support studies to include processing of nominal orbit parameters including the examination of evolution of nominal mission orbits in terms of science goals. FDD will generate predictions of orbit evolution, sun angle and shadow conditions, and special orbital events, as necessary.

Section 1. Sensor Data Processing Facility

1.1 Facility Processing and Analysis

1.1.1   General

The Sensor Data Processing Facility (SDPF) is a multi-mission facility that serves as the central location for the capture and preliminary processing of HST science data. The SDPF includes the Generic Block Recorder System (GBRS), the Packet Processor II (Pacor II), and the Data Distribution Facility (DDF). Three GBRS systems support SDPF operations and provide fail-safe data capture capabilities. Pacor II creates realtime (RT), Quick-look (QL), and routine products, and transmits RT products to the ScI. DDF receives quicklook and routine products from Pacor II and stores and transmits these products to the ScI. The SDPF to HST ScI Network Diagram is illustrated in Figure 13-1, and the SDPF mission support functional interfaces are illustrated in Figure 13-2. Data types recorded, processed, quality checked, and forwarded to the ScIF include:

   a.   Real-time science data.

   b.   Science recorder playback data.

   c.   The NSSC-I dump data.

   d.   NSSC-I status buffer readouts.

   e.   The SI microprocessor dump data.

1.1.2   Data Capture

1.1.2.1
The SDPF is capable of capturing up to 12×10^{10} bits of data, which includes ground communication overhead science and fill data, within 24 hours. It can capture up to 3×10^{10} bits of science data , and it can process and forward up to 9×10^{10} bits of science data within 24 hours. The aggregate short duration peak load of the SDPF is 2052 kb/sec. LOR playbacks can be captured simultaneously with low rate real-time data and high-rate playback. The SDPF is available in a fail-safe capture configuration seven days a week for the life of the mission. The SDPF maintains communications with the NCC for scheduling purposes according to the STDN No. 530-220.3 and 530-230.2.

1.1.2.2

All data capture activities are logged and accounted for, and discrepancies between received versus scheduled data are coordinated with the STOCC via voice circuits. All captured data are logged onto tape as they are received.

Figure 1-19. SDPF to HST ScI Network Design

Figure 1-20. Space Telescope Data Capture Facility

1.1.3 Data Quality Analysis

1.1.3.1

The SDPF performs communications link data quality and quantity analysis functions and supports fault isolation, as required. Data link quality analysis is performed to provide the detection and reporting of suspected TDRSS, Nascom line, SDPF, or HST science data quality problems, including the following:

    a.   TDRSS block polynomial error detection for each received block of data.

    b.   Nascom MDM port sequence number error detection.

    c.   Science data synchronization pattern error identification.

    d.   Cumulative BER determination based on Reed-Solomon correction.

1.1.3.2

For all quality assurance criteria, thresholds are set and monitored. When a threshold is exceeded, an alarm is generated to notify the operations personnel of the suspected problem. The NCC and STOCC control points are notified, and corrective measures appropriately coordinated.

1.1.3.3

The SDPF maintains in-house reports of the system and equipment performance and usage for analysis purposes. These reports and other pertinent data quality and accounting information are maintained and periodically transferred to nonvolatile media and stored in IPD archives.

1.1.4 Data Processing

1.1.4.1

The SDPF is capable of receiving and processing three concurrent science data streams in TDRSS format, including synchronization of the science segments, and reversal of tape recorder playback data. Reed-Solomon block synchronization error correction process, PN decoding, and down conversion are performed, as required. The science data packets are grouped into science instrument data sets. Up to 9×10^{10} bits of science data can be processed and forwarded to the ST ScI within 24 hours. However, when more than 9×10^{10} bits have been received in less than 24 hours, the SDPF delay in transmission will be consistent with a processing rate of 105 kb/sec. For all SDPF capture and processing activities, the bit error rate shall be less than one bit error in one billion bits processed; no more than one unique data set out of 100 received from Nascom should be lost or determined unprocessable because of faulty operation of the SDPF.

1.1.4.2

Processed data packets are formatted into data sets, and appropriate quality and accounting information is appended. Science data and appended information are logged to tape and stored at the SDPF. Data products are transmitted from the SDPF to the ST ScI across dedicated T1 lines. These transfers adhere to guidelines written in the *Interface Control Document between the Sensor Data Processing Facility (SDPF) and Hubble Space Telescope (HST) Consumers*, ST-ICD-92.

1.2 Data Storage

The SDPF provides data storage for received science data as follows:

a. All data are recorded at a TDRSS block level in a fail-safe configuration. The data are retained for two years unless longer retention is requested by ST ScI.

b. All processed data sets forwarded to the ST ScI are recorded and retained for 5 days on-line for routine products and 24 hours for quicklook products. Routine products are forwarded to mass storage for two years.

1.3 Operational Procedures

1.3.1 General

The following paragraphs describe the activities/procedures performed by the SDPF Analysis staff in satisfying the science data processing requirements within the HST mission operations. Areas identified include NCC science data downlink scheduling, data capture, data processing, and data delivery.

1.3.2 NCC/HST Science Downlink Schedule

1.3.2.1

Prior to receipt of the NCC science downlink scheduling information, SDPF analysts perform the following activities:

a. Verify that SDPF acquisition session resources are available and configured, including: The Communications Routing and Metering (CRAM) System, voice lines, and ICLU lines.

b. Obtain all information needed to process the different telemetry types. The information includes: Forward or reverse data, PN or non-PN encoded data, data rate, data source, and upconverted data.

c. Confirm receipt of schedules by monitoring the Schedule Interface Window, and verifying NCC receives acknowledgments.

1.3.2.2

Once the schedules have been received, the SDPF analyst displays the Acquisition Schedule Window to verify receipt of all science schedules. Manual input of schedules for an acquisition session can also be performed by SDPF analysts if schedule receipt problems are encountered.

1.3.3   Data Capture

Once a valid schedule has been received by SDPF, the system automatically sets up to receive data five minutes prior to scheduled AOS. At scheduled AOS, the SDPF analyst performs the following functions:

a. Monitors the SDPF Main Window for system alarms and advisories.

b. Monitors incoming science data by observing the increase in the number of frames and packets reassembled in the Acquisition Session Monitor Window.

c. Provides data quality checking on science data by monitoring block errors and frame errors during data capture.

d. Reports/consults with STOCC on data quality information, and assists with troubleshooting suspected line problems during data capture.

1.3.4 Data Processing

1.3.4.1 Critical Real-time Science Data Processing and Transmission

Critical real-time data are used by ScI for the calculation of reuse target offsets for revisits to a target. ScI provides SDPF with a monthly schedule of critical real-times. Once a schedule for a critical real-time sets up, the incoming data are processed by the Front-End Subsystem (FES) and packets are sent to the Real-Time Output Subsystem (RTOS). RTOS appends each packet with quality information and transmits the data to ScI within 3 seconds. Upon termination of the acquisition session, the SDPF analyst checks data quality and verifies that the number of packets transmitted is equal to the packets received.

1.3.4.2 Routine Production Data Processing

a. The SDPF generates Routine Production Data Set Files for each non-redundant instrument/observation pair captured during an acquisition session. The required turn-around time for Routine Production Products is 24 hours. The SDPF analyst performs the following:

　1. Verifies that all captured data are preprocessed.

　2. Checks data quality.

　3. Analyzes any suspected data anomalies and takes appropriate corrective actions.

b. When data quality has been verified and the data are of best quality available, products are generated. To generate a product, the SDPF analyst performs the following:

　1. Generates a product specification.

　2. Generates the product.

　3. Verifies that product generation is complete.

　4. Verifies the number of Total Detached Standard Formatted Data Unit Files, Total Dataset Files, Total Data Units and Total Data Unit Bytes.

c.   Following the completion of Routine Production Product generation, products are delivered from SDPF to the Data Distribution Facility (DDF).

1.3.4.3   Quick-Look Data Processing

a.   Quick-look data may be requested by ScI for either operational or informational purposes. For critical real-time data, a Quick-look backup may be requested to provide for recovery in event of a transmission failure. The required turnaround time for Quick-look data is 2 hours.

b.   No quality or quantity checks are performed by the SDPF analyst for data requested in Quick-look.

1.3.5   Data Transfer

1.3.5.1

The Data Distribution Facility (DDF) functions as the distribution point for all Routine Production and Quick-look products for the HST mission. DDF maintains the Quick-look files on line for 24 hours and the Routine Production files on-line for 5 days. The Mass Storage System retains all products for two years.

1.3.5.2

When Routine Production or Quick-look products are available for distribution, DDF electronically notifies the ScI. The ScI then initiates the data transfer and notifies the DDF electronically when the transfer is complete.

1.3.6   Other Processing

1.3.6.1

The Generic Block Recording System (GBRS) is the SDPF's facility for providing data archival at the TDRSS block level, immediately upon receipt of the data from WSC. Both SDPF input ports are constantly monitored and backed-up by the GBRS. After the TDRSS blocks are received they are stored on disk until the data are archived onto nine-track generic block log (GBL) tapes. The GBL tapes are archived for two years.

1.3.6.2

The GBRS normally has two redundant systems capturing data concurrently, while the third is in a standby mode.

1.3.7   Data Recoveries

On the SDPF, provisions have been made to ensure data recovery in the event data are lost due to system failure, line outages, or configuration problems, for incoming data to the SDPF or data being forwarded from the SDPF. A description of recovery systems is as follows:

a. GBRS Replay. When the PACOR II fails to capture data that have been successfully acquired by the GBRS, a GBRS replay is performed. The procedures for requesting a GBRS replay are as follows:

1. SDPF personnel determine the time span of the data to be recovered and the proper port over which the data were captured by the GBRS.

2. SDPF personnel complete the GBRS Action Request for a GBRS replay, record it onto the GBRS Priority List, and submit it to the GBRS operator.

3. When the GBRS is ready to commence the replay, SDPF personnel check to ensure that the session is set up properly.

4. Once complete, SDPF personnel assess the results of the replay and determine if additional replays are necessary.

b. LOR Recovery. In the event there is a data loss before the data are recorded on the GBRS, due to a line/equipment problem or outage, a LOR recovery is required.

1. SDPF personnel notify (verbally) the STOCC that data were not received due to a line/equipment problem, then follow up with a LOR hard copy request for retransmission.

2. The STOCC requests a LOR recovery from the NCC.

3. The LOR recovery is scheduled, SDPF personnel schedule a LOR session, capture the data, and processing proceeds normally.

c. DDF. If the ST ScI does not successfully receive routine data products from the SDPF, the ST ScI may log onto a DDF user interface and request a re-distribution of those products. The request and the re-distribution are handled electronically.

Section 1. Testing

1.1   Testing and Simulations

1.1.1   General

This section reflects the preliminary planning for testing and verification, data flows, simulations, and SM2 prelaunch testing. SM2 detailed test information may be reflected in the 501-602/Space Shuttle, HST SM2 Annex CL.

1.1.2   Scheduling Times and Dates

No attempt will be made to update this section with respect to changes in scheduling time and dates. The Network Operations Forecast and General Scheduling Messages (GSM) specify scheduling times and dates, and the briefing messages provide support details.

1.2   Testing and Verification

1.2.1

The Test and Verification (TAV) function is responsible for the HST Mission Readiness Test (MRT) program, developing the HSTOMS performance requirements, configuration management, system test plan, interface and system validation procedures, and the conduct of tests to verify performance to specifications by all elements in the HSTOMS.

1.2.2

A Memorandum of Understanding (MOU) between the Space Telescope Project, GSFC (STP-G) and the MO&DSD describes the overall ST Ground System Integration and Mission Readiness Test (GSIMRT) implementation concept. The scope and responsibilities of the HSTOMS TAV effort during ST GSIMRT are described in the MOU.

1.3   Test Types

The following types of tests are conducted to verify station, network, and project capability to support HST mission requirements.

   a.   Ground station engineering testing.

   b.   Prelaunch data flow testing.

   c.   Operational readiness testing.

d.   Joint Integrated Simulations (JIS).

e.   CITE tests.

f.   HST/KSC network tests.

1.4   Ground Station Engineering Testing

1.4.1   Test Objectives

The station engineering test objectives are to ensure that configured station equipment is capable of HST mission support.

1.4.2   Test Documentation

Testing at the GN and DSN stations will be accordance with the *Network Servicing Test Plan for HST*, STDN No. 403/HST SM and DSN NOP.

1.4.3   Station Testing Procedures

The following information is required to perform the NCP test; insert the information in the appropriate blanks in Section 11 of the Universal Station Readiness Test (USRT):

11.7 PSK Command Mode (S-Band Baseband) Test

11.7.4 Initial Test Setup

11.7.4.3c Set up the NCP follows:

(2) XT 00

(4) FO/ 16000

(6) R 00016

(7) FC 01000

11.7.4.4.b(3) Verify that the modulation index of each mode is as indicated in Table 14-1.

Table 1-22. PSK (PM) Command Mode Modulation Indices

Document No.

1.5   Prelaunch Data Flow Testing

1.5.1   Test Objectives and Description

SM prelaunch data flow tests are conducted using a simulated data source to verify the interfaces between the SN and GN and HST ground support elements. These tests also verify the mission-unique software and hardware used by each element. Scheduling and test support details are provided by test briefing messages. At least one satisfactory data flow is required between each supporting element prior to operational readiness testing.

1.5.2   Data Sources

The following equipment is used for data flow tests:

    a.   Data generator.

    b.   SOC/PSS.

    c.   Project-supplied tapes.

    d.   GSFC GSE.

    e.   SPIF.

1.5.3   Test Participants

The following personnel, ground support elements, and stations participate in the performance of HST data flows:

    a.   BDA, CAN, GDS, RID, MIL, and JPL.

    b.   WSC.

    c.   STScI.

    d.   STOCC.

    e.   FDD.

    f.   DCF.

    g.   SOC.

    h.   JSC/ESTL.

i. Nascom.

j. SPIF.

k. NCC Network Engineering Support (NEST).

l. NOM.

m. Test Director (TD).

n. GSFC TAV.

1.6 Scheduling

1.6.1
The Systems Test Branch, Code 531.1, is the GSFC organization responsible for coordinating all GN/DSN and SN tests, and simulations. In this capacity, GSFC Code 533 establishes procedures which outline the steps necessary to ensure that services and resources are properly scheduled to satisfy test and simulation requirements within Network capabilities (refer to the *Space Tracking and Data Network Tests and Simulations Handbook*, STDN No. 413).

1.6.2
Final scheduling responsibilities of STDN resources rest with Code 534.2. (Refer to the *National Space Transportation System Test Coordination Users Guide*, STDN No. 101.22.)

1.7 Test Criteria

1.7.1 Verification/Validation/Quality Check

Detailed objectives and criteria for a successful test will be contained in the briefing message for each test.

1.7.2 Reports

1.7.2.1 Test Director Test Result Reports

TD Test Result Reports (TRR) are submitted to the Network Test Manager (NTM) and NCC NM/TM immediately after conclusion of the test activities. The TD report includes:

a. Test title.

b. Date and time of test.

    c.   Test results.

    d.   Problems.

1.7.2.2 Daily Reports

The test organization transmits to various organizations, via telemail, a daily test report containing detailed information of all test activities conducted the previous day; i.e., follow-up action on past problems, identification of new problems, a schedule of near future test activities, and a daily summary test report.

1.7.2.3 Weekly Test Report

The test organization submits a weekly test report to Code 530 outlining all significant events supported the previous week, and an overall status report of planned test activities.

1.7.2.4 Test Data Packages

Major test efforts require the compilation of large amounts of data and extensive analysis. Test data packages associated with this type of effort are received, reviewed, analyzed, and approved by members of the test organization.

1.7.2.5 Anomaly/Discrepancy Follow-up

Upon completion of data analysis (delogs, test reports, etc.), the test organization verifies that a TTR exists, and depending on the magnitude of the problem, conducts meetings with the appropriate organization(s) and submits reports describing the anomaly and recommended corrective action, as applicable.

1.7.2.6 HST Unique Reporting

For all testing involving the networks, KSC, JSC, and the HST facilities, HSTOMS will prepare a report. This report is prepared for the HST Project and will contain inputs from the various elements participating in the test as well as an evaluation on the test results and a recommendation based on those results.

Table 14-1. PSK (PM) Command Mode Modulation Indices

Mode	Ranging		Command				
Mod Index	Carrier Suppression (dB)	Modulated Carrier-to-Tone	Mod Index (d	Carrier Suppression (dB)	Modulated Carrier-to-Tone	Carrier Suppression (dB)	

			(dB)	B)		(dB)	
Major Tone (Rad)	Minor Tone (Rad)						
0.29	0.29	0.4	13.2	0.78	1.37	7.53	1.77

Section 1. Data Management

1.1   Space Network

1.1.1   General

This section provides information pertaining to data distribution within the SN, and between the SN and STOCC. The information addresses SN data products.

1.1.2   Data Disposition Instructions

1.1.2.1   General

Standard procedures for management and disposition of all recorded data are contained in *STDN Network Operations Procedures for Data Management*, STDN No. 502.11. Mission-specific data disposition instructions are contained in this section. Instructions contained in paragraphs 15.1.2.2 through 15.1.2.6 are segregated by SN element for operations-related items, and by category of activity for data items generated during test or fault isolation activities.

1.1.2.2   Network Control Center

Data disposition instructions for NCC records are contained in Table 15-1.

1.1.2.3   Nascom

Data disposition instructions for Nascom are provided in Table 15-2.

1.1.2.4   Flight Dynamics Facility

All FDF products are handled in accordance with standard procedures contained in the *FDF Operations and Procedures Manual*, STDN No. 523, and applicable procedures contained in Section 15 of this document.

1.1.2.5   WSC

Data disposition instructions for WSC data items are contained in Table 15-3.

1.2　Ground Network

1.2.1　General

This section describes data management procedures for all data recorded by GN and DSN stations supporting HST.　Recorded data must be identified, annotated, labeled, packaged, and distributed in accordance with STDN No. 502.11, or this MOSP.　Spacecraft data requirements and disposition are specified in Table 15-4.

Table 1-23. NCC Data Requirements and Disposition

DSS No.	Data Label	Data Description	Data Disposition
111	2090*	UNIVAC 1100 console printouts	Hold 30 days, then destroy.
112	2090*	VAX 8530 terminal printout	Hold 30 days, then destroy.
131	2096*	UNIVAC 1100/82 dynamic dump tape	Hold 30 days, then reuse.
132	2096*	VAX log tapes	Hold 30 days, then destroy.
* Used for on-site control at station option; data labels are required for all data shipped off site.			

Table 1-24. Data Disposition Instructions for Nascom

DSS No.	Data Label	Data Description	Data Disposition
113	2090	PDP 11/23/ hardcopy	Unless otherwise directed, hold 30 days, then destroy.

Table 1-25. WSC Data Requirements and Disposition

DSS No.	Data Label	Data Description	Data Disposition
138	2102	MDM line outage recorder tape	Unless otherwise directed, hold 50 hours, then reuse.

Table 1-26. Spacecraft Data Requirements and Disposition (1 of 2)

DSS No.	STDN Data Label No.	Data Description	Disposition	
			Station	Code 562.2
Computer Complex				
110	2090	1232 input/output console printout	Hold 7 days, then destroy.	
111	2090	High-speed printer computer console printout	Hold 7 days, then destroy.	
112	2090	PDF console printout log	Hold 7 days, then destroy.	
120	2090	TDPS disk operational cartridge	If an anomaly occurs, hold until released by ISI; otherwise use continuously.	
137	2096	TDPS magnetic tape (low-speed/raw data)	If an anomaly occurs, hold until released by ISI; otherwise hold 7 days, then reuse.	
180	2090	TDPS printer hardcopy	If an anomaly occurs, hold until released by ISI; otherwise hold 7 days, then destroy.	
Command				
216	2090	NCPS line printer pass printout and postpass messages	Hold 7 days, then destroy.	
Telemetry				
530A (Prime)	2102	Magnetic tape	Unless otherwise directed by ISI, hold on station for 14 days, then ship to GSFC, Code 562.2.	Archive/ provide copies to requesters.
530B (Backup)	2102	Magnetic tape	Hold 14 days, degauss, then reuse.	
Telemetry (continued)				

Note

All DSS 530 tapes shipped off station will use three labels as follows:

      a. Attach one 2097 label to the reel, and one
      to reel container lid.

      b. Attach one 2102 label to the top narrow
      edge of the individual cardboard carton
      sleeve containing the tape.

Table 1-4. Spacecraft Data Requirements and Disposition (2 of 2)

DSS No.	STDN Data Label No.	Data Description	Disposition	
			Station	Code 562.2
Unified S-band				
603	NA	SRE processor printout	Unless directed by ISI, hold 30 days, then destroy.	
659	2090	Function/event stripchart	Unless directed by ISI, hold 30 days, then destroy.	
Tracking				
704	NA	Tracking data (paper tape for 12-meter system)	Transmit in accordance with STDN No. 502.29. Hold 14 days, then destroy.	
755	2090	Tracking function stripchart (12-meter system)	Hold 14 days, then destroy.	
774	NA	Function stripchart (12-meter system)	Hold 14 days, then destroy.	
Miscellaneous				
975	NA	PASSUM	Include applicable copies inside telemetry magnetic tape containers.	

1.2.2   Shipping Procedures

Ship requested spacecraft data by airfreight or airmail.

Shipping Address GSFC Code 562.2

NASA Goddard Space Flight Center
Receiving Officer, Building 16
Greenbelt Road
Greenbelt, MD 20771
USA
M/F Facility Management Section, Code 562.2
Attn: Archiving and Distribution

1.2.3   Magnetic Tape Numbering, Degaussing, and Recertification

Number all magnetic tapes sequentially in accordance with STDN No. 502.11. Degauss and recertify magnetic tapes in accordance with STDN No. 502.11.

1.2.4   Station Reports

All GN stations transmit TSR and shipping advisory messages in accordance with STDN No. 502.16 and Section 16 of this MOSP. Include applicable copies of TSR's inside all telemetry magnetic tape containers shipped off station.

1.2.5   Data Acceptance Criteria

1.2.5.1   General

Station pass summary information, HST playback data (PDF-E, F, G), and HST real-time data (PDF-A, B, C, D, H, K, L, M, N, O, and P) will be evaluated according to the criteria listed in paragraphs 15.2.5.2 through 15.2.5.4.

1.2.5.2   Station Pass Summary Checks

The summary of data received at the station will be checked for statements which would account for degraded or missing data. A retransmission request would not be necessary if the abnormal conditions occurred on the downlink. Such conditions would include low horizon passes, antenna autotrack problems, or RF interference from another source.

1.2.5.3   HST ETR Playback Data (PDF E, F, G, L, M, N, O, P)

    a.   Recovery playback data should be within 30 seconds of the command downlink time as reported by the STOCC.

b. The number of NASCOM blocks received should be no less than 98 percent of the number transmitted by the station.

c. The number of frames of acceptable data should be no less than 95 percent of the expected frames in the tape playback interval. Acceptable frames are minor frames that have the correct frame sync pattern at the correct interval, as well as a sequential satellite clock value, sequential frame ID, matching clock and ID values, sequential values in the station-entered time field, and a correct polynomial error code.

d. There should be no data gaps longer than 5 seconds in the transmitted data.

1.2.5.4   HST Real-time Data (PDF-A, B, C, D, H, and K)

As long as HST tape recorders function well, the STOCC should not request a retransmission of the real- time data, except when this data is required for the GMT versus spacecraft clock correlation, or when real-time data contains the only record of a critical operational period. In such cases, the following criteria should be used:

a. Recovery of real-time data should be within 30 seconds of AOS as reported by the STOCC.

b. The number of Nascom blocks received should be no less than 98 percent of the number transmitted by the station.

c. The number of frames of acceptable data should be no less than 95 percent of the expected frames between AOS and LOS. Acceptable frame definitions are described in paragraph 15.2.5.3c.

d. There should be no data gaps in transmitted data greater than 5 seconds.

Section 1. Network or NCC/Station Interface Teletype Headers

1.1   Standard Messages

1.1.1   General

Procedures and formats for standard teletype messages involved in SN activities are contained in STDN No. 502.16. Responsibility for coordinating action for these messages will be retained by the NCC. Standard messages will be designated by the header information as pertaining to an SN activity. HST specific header information is contained in the following paragraphs. Changes will be handled via DCN's.

1.1.2   Documentation Change Notice (DCN)

RR DSDN DSSW GALA GGFD GHOS GHST GPHY GSIC COMMGR FDFCOM
GUNV GWSS JFTL GNCC GJCE GJGE
DE GCEN 000
00/0000Z
FM NCC
TO ALL/STADIR/OPSR
COMMGR ALLEN DUANY THOMAS PLYLER 542.2/
DUFFY NORMAN JOHNSON
GHST/HST POCC MILLER BROOKS 519.1
GJGE/STADIR/GIDANNINI/BANGERETER/
RHODERICK OSBORN/WJOY ATSC/
OSBORNE BARRETT GONZALES SCOTT
GOMEZ WARNER GTE
GPHY/MSOCC OPS COORD/BOOTH SPIF
FDF COM/VAUGHN DOLAN 553.3
GSIC/RF SOC
GWSS/SM/OSBORNE ROMANSKY
GHOS/COMM GALA/JMCCOY BCCS/BBRADFORD AI42/NASCOM POP CDC
GJTS/COLON HERMANN BLACKWELL WILKINSON 564.1
GJCE RUEANAT/NASA HQ WASH DC/HARRIS OX/COSTRELL OT
GUNV/PC HENRY
GGFD/MITCHEL DELL
JFTL/MPSETI/LANDON
JJPL
DLD HEFFERNAN 405/ REPASS/MARIUS LEIBEE 441/BLACKWOOD/442
WYNN PILKINGTON BARBEHENN PATARO 440.8/PERKINS 510/WENTZ BPFARR
RHUGHES ONDRUS 510.1/KOSLOSKY 511/LIVELY 513/
STANLEY 515/CHRISTO DEARTH 515.1/ODONNELL CHANDLER 515.2/KINAMEN

SOMMER 519.1/FELTON 519.2/BOHNING 519.3/
FATIG 519.4/LEWIS 522.2 J. SMITH 542.1/COMMGR 542.2/WOODYARD 550/
COX 553.21 FLORES AMAYA JACKSON MARR MITCHELL DELI VAUGHN 553.3/TELES
553/
HUCKE ORPA
GUNV/PC HENRY
GGFD/MITCHEL DELL
JFTL/MPSETI/LANDON
JJPL
DLD MORSE 530/BJ HAYDEN TSOBCHAK 532.2/FLAHERTY 532.1
MTG/MOST/RICHARDS NSO/MEU/PAP/PMO/SEO/TSG/OTU/
MMU

1.1.3   Interim Support Instruction (ISI)

RR ANBE LRID JGTS DSSW GGFD GHOS GHST JFTL GJCE GSIC COMMGR GJTS GUNV
FDF COMM GNCC GJGE
DE GCEN 000
00/0000Z
FM NCC
TO (APPLICABLE STATIONS)
INFO GHST/MILLER BROOKS 519.1
COMMGR/COMMGR MOIS 542.2/DUFFY
NORMAN JOHNSON NNSG 542.1
GHOS/MSFC OPS/SKED COOPER
GJTS/COLON BLACKWELL HERMANN/564.1
GUNV/PC
JFTL/MPSETI/LANDON
JJPL/ELEURS
JOCC/OPS CHIEF
ANBE/STADIR/STA OPS
LRID/STADIR/ STA OPS
JGTS/STADIR/STA OPS
GSIC/RF SOC
GGRD/MITCHELL
GJGE RUEANANT/NASA HQ WAS DC HARRIS OX/
JIROUSEC OT
DLD HAYDEN SOBCHAK 532.2 FLAHERTY 532 WALKER 532.1
YOUNG 534.2/NOG/BARBEHENN/PAP/NSS/OTU/MMU
HEFFERNAN 405/440/440.8/REPASS LIEBEE OCHS
BARBEHENN 441/BLACKWOOD/442
PILKINGTON PATARO WYNN 440.8/DUDLEY 510/WENTZ PFARR
ONDRUS 510.1/KOSLOSKY 511/LIVELY 513/STANLEY 515/
CHRISTO DEARTH 515.1/CHANDLER ODONNELL 515.2/SOMMER KINAMEN 519.1/
FELTON 519.2/M BOHNING 519.3/FATIG 519.4/J. SMITH 542.1/

Document No.

WOODYARD 550/COX JACKSON DOLAN MITCHELL DELI
VAUGHN 553.1/TELES 553/HUCKE ORPA

1.1.4 Request For Information Clarification (RIC)

1.1.4.1 General

RR GCEN GNCC
DE GNGT 000
00/0000Z
FM OPSR
TO (APPLICABLE ELEMENTS)
GCEN HAYDEN SOBCHAK 532.2 FLAHERTY 532 WALKER 532.2/
PAP/MOST/MEU/MMU/DTU
WERBITZKY

1.1.4.2 RIC Answer

RR GCEN GNCC
DE GCEN
00/0000Z
FM NCC
TO (APPLICABLE ELEMENTS)
GCEN/HAYDEN SOBCHAK 532.2/FLAHERTY 532/
BLANEY WALKER 532.1/NOG/WERBITZKY
PAP/MOST/OTU/MMU/MEU

1.1.5 Data Shipment Advisory Message

RR GCEN GDES GSTS
DE GNGT
00/0000Z
FM OPSR
TO GCEN/NCC
INFO DLD/CODE 440.8/CODE 441/CODE 442
GDES/CODE 562.2
GTWL/532.1

1.1.6 Post-Event Report

1.1.6.1 Format

RR GCEN GTWL
DE GSTS/CODE 440.8
00/000Z
TO GCEN/NCC
INFO GTWL/WENTZ 510.1/BARBEHENN PAP NOG

LINE FEED
POST-EVENT REPORT
SUPIDEN STA SUPPRTSTART SV
A1446MS TDE YYDDDHHMMSS
LK RFT PC PFZ DT TCL DSI
XX YYN XX XXX RT XXX XXX

(Free-form text follows this line, if necessary, to describe problems occurring during the event or other pertinent information.)

1.1.6.2   Field Definition

a.   SUPIDEN.   7-digit alphanumeric support identification code defined in the Support Identification Code Dictionary, STDN No. 808.

b.   STA. 3-character, alphanumeric station identifier (TDE, TDW, TDS).

c.   SUPPRTSTART. 11-digit numeric support start time in the form YYDDDHHMMSS

where: YY   =   last two digits of the year.
            DDD   =   Julian day of year.
            HHMMSS   =   hours, minutes, and seconds (UTC)of
                                  service start.

d.   SV. Number of services or data streams being reported in this report.

e.   LK. Link

where: 00 = MAF.
               01 = SSA1.
               02 = SSA2.
               03 = KSA1.
               04 = KSA2.
               20-40 = MAR 1-20.

f.   RFT. Support type,

where: R = return service.
               F = forward service.
               T = tracking service.
               A = Y (yes) or N (no) is inserted below each character, as appropriate.

g.   PC. Problem code,

where: 00 = no problems.
               01 = poor data quality.
               02 = excessive NASCOM block errors.
               03 = acquisition problem.
               04 = reacquisition problem.
               05 = extensive data dropouts.

h.   PFZ. Percent frames with zero errors (00.0 - 9.99), or NA for not available.

i. DT. Data type,

    where: PB = playback.
                       RT = real time.

j. TCL. TDRSS Interface channel ID.

k. DSI. Data stream ID.

<div align="center">NOTE</div>

Items e. through k. are repeated for each service and/or data stream being reported. Items a. through k. are repeated for each pass being reported.

1.1.7   DCN/ISI Request

RR GCEN GTWL (Applicable elements)
DE (Applicable station)
00/0000Z
FM CODE 440.8
TO GCEN/NM/TM/NOM
INFO GTWL/LWENTZ 510.1/WERBITZKY PAP/NOG/NSS

1.1.8   Line Outage Recorder Playback Request

Refer to STDN No. 509 for the message format.

1.2   Message Unique To HST

1.2.1   General

Teletype messages unique to HST support activities are defined by use and format in this section. Teletype headers for these messages are defined in paragraph 16.2.2.

1.2.2   TTY Specific Schedule Request For Communications Service

This message is used to submit a schedule request for WSC record/playback services.

RR GCEN
DE (Applicable station)
00/0000Z
FM CODE 440.8/CODE 441/CODE 442
To NCC/Scheduling

1.2.3   HST Playback Event Add (POCC to NCC)

Refer to STDN No. 509, paragraph 7.7.

1.2.4   Data Shipment Advisory

RR GCEN GTWL GDES
DE GMIL
00/0000Z
FM OPSR
TO GCEN/NCC
INFO GTWL/WENTZ 510.1/WERBITZKY PA/NOG/NSS

1.2.5   Pass Summary Report (GN Stations Only)

(PASSUM will be used from launch through launch plus 14 days)
RR DSDS
DE GMIL
00/0000Z
FM OPSR
TO GCEN/NCC
INFO DLD/CODE 440.8/CODE 441/CODE 442

1.2.6   Telemetry Summary Report (GN Stations Only)

(TSR is used after launch plus 14 days)
RR DSDS GUNV GOPS
DE GMIL
00/0000Z
FM OPSR
TO GCEN/NCC
INFO DLD/CODE 440.8/CODE 441/CODE 442

Section 1. Television Support

1.1 STS Video Interface Requirements

The video requirements for STS are L-30 days to landing + 1 hour.

1.2 HST Requirements

1.2.1 CCTV

The CCTV requirements, live or Video Tape Recorder (VTR) documented in the SM SORD.

1.2.2 Documentary Television

Documentary television requirements are specified in DSO 0901.

Abbreviations and Acronyms

ACC   antenna control console

ACGE   analog command generation equipment

ACM   Ascension Island, U.K. (GN site)

ACS   Actuator Control Subsystem

AEDP   astrometry and engineering data processor

A/G   air-to-ground

AGC   automatic gain control

AGO   Santiago, Chile (GN site)

AM   amplitude modulation

AMU   analog multiplexer quantizer

AOS   acquisition of signal

AP   applications processor

APEX   analog parameter and event recorder

ASL   anti-sideband lock

ATSC   AlliedSignal Technical Services Corporation

AXA   area routing assembly

BBA   baseband assembly

BBS   baseband switch

BCD   binary coded decimal

BDA   Bermuda, U.K. (GN site)

BED   block error detector

BER   bit error rate

BF   block formatter

BLT   Greenbelt, MD (GN test site)

BM   briefing message

BMR   briefing message request

BOD   bright object detector

BP	batch preparation
BPA	baseband processor assembly
BPSK	binary phase shift key
BRC	block recording computer
BRL	block recorder log
BRS	Block Recorder System
BRTS	Bilateration Ranging Transponder System
BRU	block recording unit
BS	bit sync
BiO-L	biphase-L
C/D	countdown; command/data
CAB	circuit assurance block
CAIRS	computer assisted interacted resources scheduling
CAN	Canberra, Australia (26-m subnet station)
CAS	Calibrated Ancillary System
CC	configuration code
CCB	Configuration Control Board
CCC	charge current controller
CCD	charged-couple device
CCL	closed-conference loop
CCR	Configuration Change Request
CCT	Central Communication Terminal
CCTV	closed-circuit television
CDI	command data interface
CE	console engineer
CFE	communications front end
CITE	cargo integration test equipment
cm	centimeter
CMC	complex monitor and control
CMS	Command Management System

COMMGR	Communications Manager (Nascom)
COSTAR	Corrective Optics ST Axial Replacement
CP	communications processors
CPA	command processor assembly
CPM	control processor module
CPU	central processing unit
CRAM	communications rotating and metering
CRT	cathode ray tube
CS	circuit switch
CSC	Computer Sciences Corporation
CSM	command spacecraft memory
CSR	Customer Support Room, JSC
CSS	Communications Switching Subsystem; Nascom Control and Status System; Coarse Sun Sensor
CSSA	coarse sun sensor assembly
CSTC	Consolidated Space Test Center
CTA	CTA, Inc.
CTB	communications test block
CTV	compatibility test van
CU/SDF	control unit/science data formatter
CW	carrier wave
DASDF	DFF 224 Analysis and Software Development Facility
dB	decibel
DBCI	data base change instruction
DBCN	data base change notification
DBCR	data base change request
dBi	dB isotropic
DBM	Data Base Manager
DCN	documentation change notice
DDPS	Digital Data Processing System
DEC	declination

DFE   data flow engineer (JSC-MCC)

DFRF   Dryden Flight Research Facility

DG	data generator, data group
DGIB	DSN/GSFC interface block
DIFS	display input file schedule
DIR	director
DIS	Data Interface System
DIU	data interface units; digital interface unit
DKR	Dakar (STS support site)
DLMS	data link monitoring system
DMA	direct memory access
DMBK	deployment umbilical mounting bracket
DMCS	Digital Maintenance and Control Subsystem
DMS	Data Management Subsystem; digital matrix switch
DMU	data management unit
DOC	Data Operations Control
DOD	Department of Defense
DQM	data quality monitoring
DQMS	Data Quality Monitoring System
DRG	digital ranging generator
DRS	Data Recording System
DSA	Demodulator Synchronized Assembly
DSCC	Deep Space Communications Complex
DSCS	Defense Satellite Communication System
DSID	data stream ID
DSM	Data Systems Manager
DSN	Deep Space Network
DSS	Digital Switching System
DSSC	Data Synchronizer Setup Controller
DSTIF	Data Software Test and Interface Facility
DTS	Data Transfer System

EC	engineering change
ECS	error correction and switching
EDU	Evaluation/Documentation Unit
EET	end-to-end test (STGT)
EGSE	electrical ground support equipment (LMSC, Sunnyvale, CA)
EIRP	effective isotropic radiated power
EPROM	Erasable Programmable Read-Only Memory
EPS	Electrical Power Subsystem
EPTCE	electrical power/thermal control electronics
EPTCS	Electrical Power/Thermal Control Subsystem
ER	equipment room, Eastern Range
ESA	European Space Agency
ES0	Experiment Systems Office
ESS	Engineering Support System
ESTIF	Extended Software Test and Integration Facility
ESTL	Electronic Systems Test Laboratory
ESTR	engineering science tape recorder
ETE	end-to-end
ETR	engineering tape recorder
EVA	Extra-vehicular Activity
EWG	External Users Gateway
F	fahrenheit
F/S	frame synchronizer
FA	frame analyzer
FDD	Flight Dynamics Division (GSFC, Code 550)
FDF	Flight Dynamics Facility
FDSDIC	Flight Data System Development and Integration Center
FDX	full duplex (TTY)
FGE	fine guidance electronics
FGS	fine guidance sensor

FHST	fixed-head star tracker
FIFO	first-in, first-out
FIMS	Fault Isolation and Monitoring System
FM	frequency modulation
FOC	faint object camera
FOS	faint object spectrograph
FOSP	Flight Operations Support Plan
FOT	Flight Operations Team
FOV	field-of-view
FRD	Functional Requirements Document
FSL	flight software load
FSM	first servicing mission
FSS	Flight Support System, frame synchronizer subassembly
FS&S	flight systems and servicing, Flight Support System
ft	feet
GAR	GSFC amplifier rack
GBL	generic block log
GBRS	Generic Block Recording System
GCF	Ground Communication Facility
GCM	ground control message
GCMR	ground configuration message request
GDS	Goldstone, CA, DSN (26-m subnet station)
GEA	Gimbal Electronic Assembly
GFE	government-furnished equipment
GHRS	GSFC high-resolution spectrograph
GHz	gigahertz
GMT	Greenwich mean time
GN	Ground Network
GNSO	Ground Network Scheduling Office
GPC	general purpose computer

GPS	Global Positioning System
GRS	GSFC high-resolution spectrograph
GS&O	ground system and operations
GSE	ground support equipment
GSFC	Goddard Space Flight Center
GSIMRT	ground system integration and mission readiness test
GSM	general scheduling message
GTDS	Goddard Trajectory Determination System
GVU	ground verification unit
GWM	Guam, Mariana Island (GN site)
HAW	Kokee Park, Kauai, MI (GN site)
HGA	high gain antenna
HLD	High level discrete
HOSC	Huntsville operations Support Center
HRS	high-rate switch
HSDL	high-speed data line
HSIF	Hardware/Software Integration Facility (LMSC, Sunnyvale, CA)
HSP	high-speed photometer, high speed printer
HST	Hubble Space Telescope
HSTGS	HST Ground System
HSTP	Hubble Space Telescope Project
HSTOCC	Hubble Space Telescope Operations Control Center
HSTOMS	Hubble Space Telescope Observatory Management System
Hz	Hertz (cycles per second)
I	inphase
I&C	Instrumentation and Communication Subsystem
I/O	input/output
IAD	Interface Agreement Document
IBDDR	Inter-Building Dissemination Resource
IBDTS	Inter-building Data Transfer System

ICBC	IMAX cargo bay camera
ICD	Interface Control Document
IDB	internal data bus
IF	intermediate frequency
IFOV	instantaneous FOV
IIRV	improved interrange vector
IL	input log
in.	inch
IP	intercept point
IPCU	interface power control unit
IPD	Information Processing Division
IRIG	Interrange Instrumentation Group
ISI	interim support instruction
ITU	input terminal unit
IVT	integration verification test
JHU	Johns Hopkins University
JIS	joint integrated simulation
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
k	kilo
kb/sec	kilobit per second
kg	kilogram
kHz	kilohertz
km	kilometer
KCRT	keyboard cathode ray tube
KSA	K-band Single Access
KSC	Kennedy Space Center
Ku-band	15.250- to lj.25O-GHz
LAN	Local Area Network
lbs	pounds

LC	link consoles
LCC	Launch Control Complex
LCP	left-hand circular polarization
LGA	low gain antenna
LHC	left-hand circular
LMC	link monitor and control
LMP	link monitor processor
LMSC	Lockheed Missile and Space Company, Inc.
LOF	local oscillator frequency
LOR	line outage recording; line outage recorder
LOS	loss of signal
LOTTS	Long-Term Trending Software
LRT	link readiness test
LTU	liftoff time update; line test unit
m	meter
Mv	apparent visual magnitude
MA	multiple access (antenna service)
MACS	MDM Automated Control System
MAF	MA forward
MAR	MA return
Mb/sec	megabits per seconds
MCC	Mission Control Center (JSC)
MCD	maximum convolutional decoder
MD	memory dump
MDA	metric data assembly
MDB	multiplex data bus
MDM	multiplexer/demultiplexer
MFR	multifunction receiver
MMz	megahertz (megacycles per sec)
MIL	Merritt Island, FL (GN site)

MILA	Merritt Island, FL (DOD tracking site)
μm	micrometer
MO&DSD	Mission Operations and Data Systems Directorate
MOC	mission operations computer; mission operations contractor
MOD	millisecond of day
MODEM	modulator/demodulator
MOM	Mission Operations Manager
MOR	Mission Operations Room
MOSES	Mission Operations, Systems Engineering, and Software
MOSP	Mission Operations Support Plan
MOU	memorandum of understanding
MPA	Metric Pointing Assembly
MPT	Mission Planning Terminal
MRS	monitor recorder simulator; MIL Relay System
MRT	mission readiness test
m/s	meters per second
MS	message switch
MSB	most significant bit
MST	most significant bit
MSFC	Marshall Space Flight Center
MSFTP-2/3	manned spaceflight telemetry processor
MSM	Mission Support Manager
MSR	Mission Support Room
MSS	Magnetic Sensing System; Message Switching System
MTB	magnetic torque bar
MTG	Mission Test Group
MTP	master timing pulse
MTR	magnetic tape recorder
MVIP	micro-virtual interface processors
Mb	Megabit

NA	not applicable
NASA	National Aeronautics and Space Administration
Nascom	NASA Communications Network
NASCOP	NASA Communications Operating Procedures
NC	Network Controller (NCC)
NCC	Network Control Center
NCCDS	NCC Data Systems
NCE	Network Communication Center
NCP	Network consolidation program, Network command processor
NCPS	Network Command Processor System
NCSS	NGT Control and Status System
NDU	Network Documentation Unit
NES	Nascom event schedule
NEST	Network Engineering Support Team
NFB	NCC fallback
NGT	NASA Ground Terminal
NICMOS	Near Infrared and Multi-Object Spectrograph
NM; nm	Network Manager (NCC) nanometer
nmi	nautical mile
NMSS	Nascom Manual Scheduling System
NOCC	Network Operations Control Center, JPL
NOM	Network Operations Manager
NOP	Network Operations Plan (JPL)
NOPE	Network Operations Project Engineer
NPBA	NCC playback event add
NPBD	NCC playback event delete
NPBR	NCC playback event reject
NPEA	NCC playback event add
NPED	NCC playback event delete
NPER	User playback event delete

NRZ-L	non-return to zero level
NRZS	non-return to zero space
NSP	NASA Support Plan; network signal processor
NSS	NGT Scheduling System; navigation synchro switchboard; Network Support Subsystem
NSSC	NASA standard spacecraft computer
NSTS	National Space Transportation System
NTHC	NCC tape hold cancel

NTHR	NCC tape hold request
NTM	Network Test Manager
NUTI	Nascom user traffic interface
O&GS	Operations & Ground System
OBC	onboard computer
OC	onboard computer; Operations Controller
OCC	Operations Control Center
OCD	Operations Control Directives
OCS	Optical Control Subsystem
OCXO	oven-controlled crystal oscillator
OD	operational downlink
ODM	operations data message
OFLS	Offline System
OI	operational instrumentation
OLS	Online System
OM	Operations Manager
OMI	operations & maintenance instruction
OPM	operational message
OPS	operations
OPUS	Observation Support System
OPSR	Operations Supervisor
OR/OD	Operations Requirements/Operations Directive
ORD	Operations Requirements Document
ORI	Orbital Replacement Instrument
ORU	Orbital Replacement Unit
OSID	Operational System Interface Document
OTA	optical telescope assembly
OTU	output terminal unit
OV	Orbiter vehicle; orbital verification
OVFL	overflow

PAOS	predicted AOS
P-E	Perkin-Elmer Corporation
P/L;PL	payload
P/S	parallel/serial
PA	Performance Analyst (NCC); power amplifier
PAOS	predicted AOS
PASS	POCC applications software support
PASSOPS	POCC application software support operations
PASSUM	pass summary (message)
PB	playback
PBF	payload block formatter
PBM	Pass Briefing Message
PCL	parallel communications link
PCM	pulse code modulation
PCMMU	PCM master unit
PCR	Payload Changeout Room
PCS	Pointing Control Subsystem
PCU	power control unit
PDB	project data base
PDF	programmable data formatter
PDI	payload data interleaver
PDIS	PDI serializer
PDL	Ponce de Leon (Space Shuttle support site)
PDT	performance demonstration test
PDU	power distribution unit
PEP	polynomial error protector
PER	post-event report
PET	performance evaluation test
PI	payload interrogator
PIP	payload integration plan

PIT	processor interface table
PM	phase modulation
PMS	Portable Maintenance System
PN	pseudorandum noise
POCC	Payload Operations Control Center
PODPS	Post Observation Data Processing System
PPF	payload parameter frame
PRD	Program Requirements Document
PRS	PORTS Replacement System
PRT	prepass readiness test
PSAT's	predicted site acquisition tables
PSEA	pointing/safing electronics assembly
PSK	phase shift key
PSO	Production Support Office
PSP	payload signal processor; Payload Support Plan
PSS	Portable Simulation System
PSTOL	PORTS system test and operations language
PTCR	Payload Test Control Room
Q	quadrature-phase
QPSK	quadriphase shift key
R&RR	range and range rate
R-S	Reed-Solomon
R/T;RT	real time
RA	right ascension
RB	rate buffered
RCC	Range Control Center
RCP	right-hand circular polarization
RER-MC	Range-Error-Rate-Master Controller
RF	radio frequency
RGA	rate gyro assembly

RIC	request for information clarification
RID	Madrid, Spain (DSN 26-m subnet station)
RIU	remote interface unit
RM	request for modification
RMGA	retrieval mode gyro assembly
RMS	Remote Manipulator System
ROM	read-only memory
RSS	rotating service structure
RT	real time
RTC	real-time combiner
RTS	remote tracking site
RVS	routine verification services
RWA	reaction wheel assembly
RX	receiver
S&M	Structures and Mechanical Subsystem
S-band	1500 to 5200 MHz
S/P	serial/parallel
S:N	signal-to-noise ratio
SA	signal access (antenna service); solar array
SAIL	Shuttle Avionics Integration Laboratory (JSC)
SAMS	support and maintenance system
SAOS	simulated AOS
SAR	schedule add requests
SATS	Spacecraft Automated Test System
SC	spacecraft
SCAMA	switching, conferencing, and monitoring arrangement
SCAN	Software Catalog for the Network
SCAR	Spacecraft Analysis Room
SCE	spacecraft command encoder
ScIF	Science Institute Facility

SCM	Satellite Control Network
SCO	subcarrier oscillator
SCP	station communication processor
SCR	strip chart recorder
SDPF	Sensor Data Processing Facility
SDS	SUE Data System
SE	ground support equipment
SEER	Systems Engineering and Evaluation Room
SEU	single event upset
SFL	Shuttle Forward Link
SGLT	Space-to-Ground Link Terminal
SHO	scheduling order
SHS	Special Hardware System
SI	scientific instrument
SIC	Spacecraft Identification Code
SIC&DH	SI command and data handling
SIRD	Support Instrumentation Requirements Document
SLDPF	Spacelab Data Processing Facility
SLOS	simulated LOS
SM	statistical mux; Servicing Mission
S&M	Structures and Mechanical Subsystem
SMC	science monitor console; status & monitoring console
SMOR	Servicing Mission Operations Room
SMOV	Servicing Mission Observatory Verification
SM/PART	SM/Planning Replanning Tool
SMS	science mission specification; Shuttle mission simulator
SN	Space Network
SO	Scheduling Operator (NCC)
SOC	Simulations Operations Center
SOGS	Science Operations Ground System

SORD	Systems and Operations Requirements Document (NM only)
SPC	stored program command; Signal Processing Center
SPIF	Shuttle POCC Interface Facility
SPSS	Science Planning & Scheduling Subsystem
SQPN	staggered quadriphase pseudonoise
SRE	STDN ranging equipment
SRM	schedule result message
SRT	station readiness test
SS	Shift Supervisor
SSA	S-band single access
SSAF	SSA forward
SSAR	SSA return
SSC	Science Support Center (STOCC)
SSE	space support equipment
SSI	software support instruction
SSIU	SUE System Interface Unit
SSM	support systems module; Site Status Message
SSP	Space Shuttle Program
SSR	specific schedule request
SSS	star selector servos
ST-ECF	ST European Coordinating Facility
STA	station
STADIR	Station Director
STACC	standard telemetry and command components
STDN	Spaceflight Tracking and Data Network
STGS	ST Ground System
STGT	Second TDRSS Ground Terminal
STIF	Software Test and Integration Facility
STINT	standard interface for computer
STO	Space Telescope operations (Com line)

STOCC	Space Telescope Operation Control Center
STOCCOPS	Space Telescope Operation Control Center operations
STOMS	ST Observatory Management System
STP-G	ST Project-GSFC
STPS	Station Tracking Processor System
STR	science tape recorder
STS	Space Transportation System
STScI	Space Telescope Science Institute
STTR	STDN tracking trouble report
SUE	Shuttle-unique equipment; system utilization enhancement
SUPIDEN	support identification code
TAGS	Text and Graphics System
TAV	test and verification
TBD	to be determined
TBS	to be supplied
TCA	Telemetry Channel Assembly
TCDS	Telemetry Command Data System
TCS	Thermal Control Subsystem
TCT	time code translator
TD	Test Director
TDA	telecommunications and data acquisition
TDE	TDRS East
TDM	time division multiplexed
TDPS	Tracking Data Processing System
TDR	tracking data router
TDRS	Tracking and Data Relay Satellite(s) System
TDS	TDRS Spare
TDW	TDRS West
TESOC	Telemetry Software Catalog
TL	talk listen

TM	Test Manager (NCC)
TN	TDRSS Network
TNC	TDRSS Network Controller (NCC)
TO	test output
TOCC	TDRSS Operations Control Center
TP	telemetry processor
TPF	Telemetry Processing System
TPS	test preparation sheet
TRACKON	Track Controller
TTAC	transportable telemetry and command
TT&C	telemetry, tracking & command
TRR	test results report
TTY	teletype
TWTA	traveling wave tube amplifier
TSM	Terminal Services Manager
TSR	telemetry summary report
TTR	TDRSS trouble report
TX	transmitter
UARS	Upper Atmosphere Research Satellite
UDM	umbilical disconnect mechanism
UHF	ultra-high frequency
UL CMD	uplink command
UPBA	user playback add
UPBD	user playback delete
UPD	user performance data
UPEA	user playback event add
USB	unified S-band
UPS	User Planning System
USRT	Universal Station Readiness Test
USS	User Services Subsystem

UT	Universal Time
UTC	Universal Time Coordinated
UV	ultraviolet
V	volt
VDS	Voice Distribution System
VP	TDRS visibility period (exit ZOE to enter ZOE)
VAP	Verification and Acceptance Program
VDC	volts direct current
VEST	vehicle electrical systems test
VIC	vehicle identification code
VIP	virtual interface processor
VPF	Vertical Processing Facility
VTR	video tape recorder
Vpp	Volts peak-to-peak
Vrms	Volts root-mean-square
W	watt
WBMTR	wide band magnetic tape recorder
WCSS	West Coast Switching Center
WETF	Weightless Environment Testing Facility
WF/PC II	wide field/planetary camera II
WPS	Wallops Island, VA, (GN site)
WSC	White Sands Complex
WSGT	White Sands Ground Terminal
WR	Western Range
XIU	X.2 Interface Unit
YAR	Yarragadee (STS support site)
ZOE	zone of exclusion

Appendix. References

This Appendix is not intended to provide a complete list of applicable documents covering all MO&DSD ground system interfaces and standard interface procedures. Where standard interface procedures are not available, those procedures will be contained in the applicable sections of this document until such time as the interface procedures become available. True mission-unique interface procedures will be contained in the applicable sections of this document. A sample of typical standard documents is as follows:

a. *TDRSS Network System Operating Concepts*, STDN No. 119.

b. *Data Format Control Document Between the Goddard Space Flight Center Payload Operations Control Center and the Network Control Center*, STDN No. 230.1.

c. *STGT/WSGTU Operating Procedures*, STDN No. 534 SOP/WSC, Vol. 1 and 2.

d. *STDN Network Operations Procedures for Data Management*, STDN No. 502.11.

e. *Network Operations Control Center and Station Interface Procedures*, STDN No. 02.16.

f. *Network Control Center/Space Network Real-time Fault Isolation Procedures*, 530-NOP-NCC/SN.

g. *Operations Interface Procedures Between the GSFC Network Control Center and Flight Dynamics Facility*, STDN No. 508.35.

h. *Network Control Center Standard Operating Procedures*, STDN No. 517.20, Volumes 1 and 2.

i. *NCC Data Base Configuration Control Procedure*, STDN No. 910.1.

j. *NASA Communications Operating Procedures (NASCOP)*, Volume II.

k. *Standard Operations Interface Procedures Between the Network Control Center and Spaceflight Tracking and Data Network Users*, STDN No. 509.

l. *TDRSS Operational System Interface Document (OSID)*, Document No. WU-02-17, Revision C, February 20, 1985, SCN-1, 3C, 3A.

m. *TDRSS Scheduling Order (SHO) and Operations Message (OPM) Format and Content Guide*, W200A039.

n. *TDRSS Operations Procedures Interface Control Document (ICD).*

o. Applicable *Interface Control Documents*, STDN No. 220 series (Users).

p. *Space Network (SN) Users Guide*, Revision 6, STDN No. 101.2, September 1988.

q. *Performance Specification for Services via the TDRSS*, S-805.1.

r. *Interface Control Document Between the Jet Propulsion Laboratory and the Goddard Space Flight Center for GSFC Missions Using the Deep Space Network for Space Telescope*, MDD-1ICD/0182.

s. JPL DSN 870-series documentation.

t. *Data Format Control Document Between the Goddard Space Flight Center Operations Support Computing Facility and the Network Control Center*, STDN No. 230.6.

u. *Interface Control Document (ICD) Between the NASA Communications Division (NASCOM) and the Flight Dynamics Facility (FDF)*, STDN No. 220.2.

v. *MCC/JSC/Remote POCC Requirements Payload Operations Control Center Annex* (PIP Annex No. 5; JSC 14009, Annex 5).

w. *Network Control Center Users Data Base Management and Control Plan*, STDN No. 910.

x. *Tracking and Data Relay Satellite System Network Operations Support Plan for the National Space Transportation System*, 501-602/Space Shuttle.

y. *Tracking and Data Relay Satellite System (TDRSS) Functional Description*, STDN No. 117.

z. *Telemetry Software Catalog (TESOC) for LSI-11 Microprocessor, Setup Controller (SUC), Data Synchronizer Setup Controller (DSSC), and Data Generator (DG)*, STDN No. 515.5.

aa. *STDN Network Operations Procedures for Telemetry Systems*, STDN No. 502.2.

ab. *STDN Network Operations Procedures for the RER Upgrade System*, STDN No. 502.40.

ac. *Operations Interface Procedures Between the Spaceflight Tracking and Data Network (STDN) Network Control Center (NCC) and Deep Space Network (DSN) Network Operations Control Center (NOCC)*, 534-OIP-NCC/DSN NOCC.

ad. *STDN Network Operations Procedures for Configuration Control*, STDN No. 502.17.

ae. *Operations Interface Procedures Between the Goddard Space Flight Center Network Control Center and NASA Communications Network*, STDN No. 508.32.

af. *Interface Control Document Between the Network Control Center (NCC) and the Sensor Data Processing Facility (SDPF)*, STDN No. 220.3.

ag. *Data Format Control Document Between the Goddard Space Flight Center Sensor Data Processing Facility and the Network Control Center*, STDN No. 230.2.

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501/603/HST

MISSION OPERATIONS AND DATA SYSTEMS DIRECTORATE

**Mission Operations Support Plan
(MOSP) for the
Hubble Space Telescope (HST)**

Revision 2

September 1996

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

Mission Operations Support Plan (MOSP)
for the
HST

September 1996

Prepared by:

Name	Date
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Goddard Space Flight Center
Greenbelt, Maryland

Preface

The purpose of the Goddard Space Flight Center (GSFC) Mission Operations and Data Systems Directorate (MO&DSD), Code 500, Mission Operations Support Plan (MOSP) for the Hubble Space Telescope (HST) is to provide mission-unique operational procedures and configuration information required by the MO&DSD elements, Jet Propulsion Laboratory (JPL) Deep Space Network (DSN), and Hubble Space Telescope Operations Control Center (STOCC) during MO&DSD and JPL DSN support of the HST Project. Standard procedures for intra- and inter-element operations and for STOCC interface activities are defined in reference documents contained in the appendix of this MOSP. Where referenced conflicts exist with other documents, the provisions of this document take precedence.

The configuration information contained in this document includes both automated data base contents and manual configuration instructions as appropriate to the element. In providing this mission-unique information, this document forms the point of control for automated data bases in use in the MO&DSD and for the manual configurations required.

This issue of the document has been developed to accommodate the needs of normal MO&DSD and JPL DSN operations supporting HST. When appropriate, this document will be upgraded by revision or Documentation Change Notice (DCN) phase information.

Between revision or reissue cycles, all changes to this document, and thus to data bases, manual configurations, and mission-unique procedures contained herein, will be made by DCN. At present, the procedures defined within the Network Control Center (NCC) and Station Interface Procedures, STDN No. 502.16, with the exception of the DCN approval cycle, will be used for DCN implementation. DCNs to this issue will be coordinated with the appropriate MO&DSD line organizations and approved by Codes 501/510.1.

Questions from MO&DSD elements, the JPL DSN, or project organizations concerning the information contained in this document should be transmitted to the Network Control Center (NCC) using Request for Information or Clarification (RIC) procedures as defined in STDN No. 502.16. RICs or DCN/Interim Support Instructions (ISI) responses will be coordinated through Codes 501/510.1, as appropriate. Teletype headers for these messages are contained in Section 16.

All other questions or comments regarding this document may be addressed to:

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